United States Naval Mine Warfare Plan

Third Edition

Fiscal Year 1996-1997 Programs

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CONTENTS

FOREWORD

Mine Warfare Forward ...From the Sea

Perhaps as never before, the U.S. Navy and Marines Corps are operating today as a seamless team — integrated in planning, in exercises, and in forward-deployed operations; in projecting our national interests both on the high seas and in the world's littorals; in defending national and allied interests; and in power projection during crisis and conflict. The threat posed by mines, especially in the pursuit of our interests in the littorals, is one that must not be allowed either to inhibit or deter us from our ability to execute our nation's taskings. Fortunately, we are at a point where our commitment and technological advances are merging to produce an environment where the threat posed by mines need no longer be as redoubtable as it once was. The threat, while still diverse and complex, is manageable if we take advantage of the current opportunity available to naval forces.

The foundation of this edition of the *Mine Warfare Plan* rests on the conviction that mine warfare must assume its rightful place among the warfighting specialties resident in our Navy and Marine Corps. It must be fully integrated, and it must have both dedicated and organic capabilities in order to assume this rightful place. Mine Countermeasures (MCM) must be within the mainstream of naval operations, from doctrinal development to operational planning and tactical execution. An integrated approach to mine warfare must also shape current and future research, development, and modernization efforts.

Mine warfare has become one of the essential keys to unlocking the littoral battlespace. As such, we are intent on putting in the hands of the Sailors and Marines who sail in support of our nation's bidding, the capabilities to defeat the mine threat, accomplish the mission, and return home safely. Towards that end, we must give attention to funding high pay-off programs that meet our requirements in support of the Concept of Operations and this Plan. We should and will do no less.

Jeremy M. Boorda
Admiral, U.S. Navy
Chief of Naval Operations

C. C. Krulak
General, U.S. Marine Corps
Commandant

MINE WARFARE FOR THE 21ST CENTURY

New Challenges...New Solutions

The end of the Cold War provoked prompt reevaluation of our national priorities and interests in light of changing world alignments and regional tensions. With undisputed command of the seas, the Navy and Marine Corps turned increasing attention to solving the complex problems of joint operations in the littoral, where economic and political instabilities are most likely to spark unrest, and conflicts affecting our national interests and those of our allies are most likely to occur.

From the *National Security Strategy*, calls emerged for the military to meet aggression with a three-pronged approach of engagement, partnership, and prevention. This requires significant forward presence, involving larger numbers of naval forces in crisis-prone regions, to quell immediate crises, to convey the initial national response, to project effective military power, and to supply and support wartime projection forces in time of war.

The Navy Department's response to emerging operational requirements was articulated in the 1992 strategic concept paper *...From the Sea*. This naval strategy marked a shift in our operational priorities, requiring that we no longer focus our plans and programs on the containment of a global maritime power, but rather on the projection of power from the sea to contain regional disruptions before full-scale conflict erupts. Further development of this naval strategy, disseminated in the 1994 follow-on document *Forward ...From the Sea*, underscores the need for naval forces to be prepared to control all elements of the anticipated battlespace. This includes areas that, as emphasized by our experiences during the past 50 years, will be mined.

Worldwide proliferation of mines compounds this problem. Currently, there are 49 countries possessing mining capabilities. Of these, at least 30 have demonstrated a mine production capability and 20 have attempted to export these systems. Proliferation has recently been driven by the commercialization of many former Soviet military systems — especially mines. Russia has continued to market and sell mines as part of its foreign military sales program. The People's Republic of China actively sells mines as well.

Proliferation represents a quantitative as well as a qualitative threat. Contact mines designed in 1908 can still be found in world inventories and will continue to be used simply because they are relatively inexpensive and simple to manufacture,

obtain, and maintain. While their lethal range is not as great as newer mines, their mere existence poses a potential threat. Indeed, the psychological nature of the mine threat is one reason why mine warfare is so effective.

The U.S. Navy previously published *Mine Warfare Plans*, in part to serve as a measure for congressional review. The first edition (January 1992), written shortly after the 1991 Gulf War, established a foundation for mine warfare improvement — predominantly in mine countermeasures — in direct response to lessons learned in the Gulf. The plan highlighted major developmental excursions in shallow water mine countermeasures. The shallow and very shallow water regions impact overall expeditionary warfare operations — specifically amphibious operations — the most.

The second edition of the *Mine Warfare Plan* appeared in February 1994. It built upon the first edition, outlining new developments in mine surveillance, reconnaissance, and remote mine countermeasures. Receiving increasing interest, the second *Mine Warfare Plan* was circulated to all members of Congress and associated staff personnel, all Navy and Marine Corps operational commands, and cognizant public and private research and development concerns, and was provided to our allies.

The 1996 edition of the *Mine Warfare Plan* continues to build upon the programs and initiatives described in previous editions, providing additional insight to the overall U.S. Navy and Marine Corps Mine Warfare program and operational structure. It also provides a concise description of our evolving mine warfare "Concept of Operations" and the architecture upon which our future mine warfare capability is being built. The Third Edition of the *Mine Warfare Plan*:

- Explains how U.S. Naval Forces will conduct mine warfare operations
- Assesses our mine warfare strengths
- Identifies capability shortfalls
- Outlines our initiatives for providing the mine warfare capabilities our naval forces will require in the 21st century

The *Mine Warfare Plan* also includes summaries of mine warfare technologies and the associated programs designed to meld these new technologies into the operational environment.

Our hope is that the reader will gain an understanding of the critical role mine warfare plays in the nation's post-Cold War national and maritime strategies and also be able to assess our current and projected capability to support mine warfare requirements.

MINE COUNTERMEASURES

Concept of Operations

Mine warfare's operational role, or concept of operations, is central to the *Mine Warfare Plan* in anticipating future military scenarios. In light of experiences in the Persian Gulf, mine countermeasures deserve particular attention within that concept.

In terms of cost-effectiveness and impact on the littoral environment, mines are the single most attractive weapon available to anyone intent on inhibiting the ability of U.S. Naval Forces to project power from the sea. Mine countermeasures therefore are critical to the ability of naval forces to effectively shape and dominate the battlespace. This includes not only locating and neutralizing mines, but also identifying those areas where mines are not present. Elimination of mines can be accomplished by physical clearance, destruction of mine stockpiles, obstruction of mine movement to mine laying platforms, or destruction of the minelaying platforms themselves.

To deal with the mine threat, naval forces require a viable concept of operations for mine countermeasures. Such a concept of operations must be prudently broad in scope to ensure our technical and operational capabilities span the spectrum of potential operations, from non-combat operations to full-scale conflict.

Mine countermeasure operations must begin during peacetime with actions that baseline relevant environmental data and intelligence information on mining capabilities. As tensions increase, focused surveillance operations will provide updates to these databases. As tensions escalate further, naval forces will be expected to conduct organic mine countermeasures operations as part of their initial efforts to shape the battlespace. Organic mine countermeasures operations will augment the dedicated efforts of deployable mine countermeasures forces which may be required to clear enemy mines in order to better shape the battlespace and ensure our ability to project power from the sea.

Role of Mine Countermeasures

Forward-deployed U.S. Naval Forces will possess the primary U.S. capability to shape the battlespace within the theater of operations. In order to maximize this capability, naval forces must be allowed unencumbered maneuver. As our forces build up in theater, we evolve to battlespace dominance. This build-up is attained only if we can safely sail our forces across the sea lines of communications and into littoral operating areas and ports of debarkation. Depending on the desired mission objective and level of conflict, battlespace dominance will support power projection. To succeed, naval and joint forces must be able to deal with a multitude of threats, including the mine threat. To attain battlespace dominance, U.S. Naval Forces must be capable of conducting operations supporting mine countermeasures. To accomplish the mission, naval forces must also be able to transition seamlessly to combined, coalition operations and warfare.

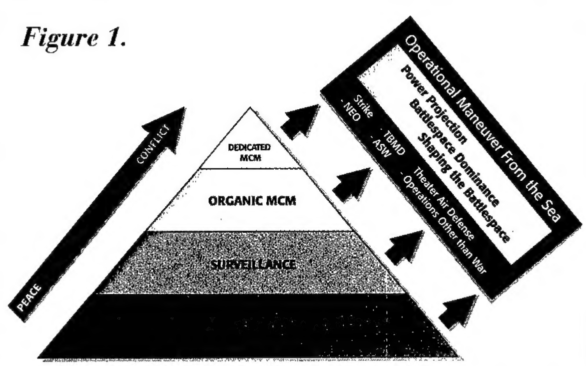
The Concept of Operations (CONOPS) provides a road map to counter the mine threat challenging naval forces and is designed to ensure the ability to maintain the freedom of maneuver from the sea.

Our Mine Countermeasures CONOPS entails a synergistic mix of mine countermeasures-focused operations that build upon each other to provide naval forces the capability to counter the mine threat. The four general types of mine countermeasures operations are:

- Mapping, Survey and Intelligence Operations
- Surveillance Operations
- Organic Mine Countermeasures Operations
- Dedicated Mine Countermeasures Operations

These operations build on each other in a pyramid-like manner as illustrated in Figure 1. Each is enabled by the operation preceding it. As tensions escalate, mine countermeasures operations will focus greater levels of effort in increasingly smaller geographic areas.

Figure 1.

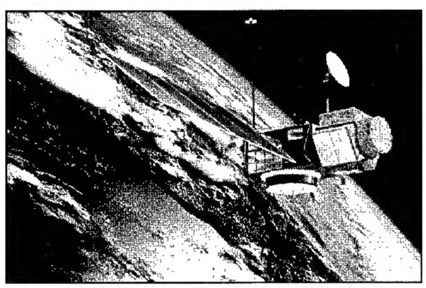


Depending on the threat, success may be achieved in a particular mission objective at any level of the pyramid. The essential features of each level of mine countermeasures operations are described in the following paragraphs.

Mapping, Survey and Intelligence Operations

Although we cannot pinpoint the next geographic location where naval forces will be required to conduct operations, it is likely that mines will threaten naval forces in the littorals and strategic "choke points" of the sea lines of communication. It is also certain that naval forces will face a complex mine threat, one varying widely in technical sophistication. A sustained, peacetime mine countermeasures-oriented bottom mapping and environmental survey effort as depicted in Figure 2, combined with an aggressive, all-source intelligence collection effort is required to provide the foundation databases required to support mine countermeasures operations.

Mine countermeasures-oriented bottom mapping and environmental databases will be used to determine the extent of mineable waters, potential for mine burial, as well as the acoustic and magnetic propagation characteristics of the particular area.



Mine threat intelligence exploitation will provide technical data on the threat, as well as the location of stockpiles, mine laying platforms, minelaying tactics, and mine laying proficiency of a potential enemy.

Figure 2.

MAPPING, SURVEY and INTELLIGENCE OPERATIONS

ATTRIBUTES	ASSETS	PRODUCTS
• Conducted Far in Advance of Possible Conflict	• National Sensors	• MCM Planning Folders
• Synergistic Use of All Assets	• Intel Techniques and Platforms	• Foreign Mine Exploitation
• Available to All of the Components of Joint Force Through C^4I	• Oceanographic Survey	• Threat Assessment
• Worldwide Focus	• Allies	• Threat Inventories, Laying, & Production Capabilities
• Full-Time Focused Effort	• Forward Deployed Forces of Opportunity	• Tactics, Techniques, and Procedures
• Leverage Other Warfare Areas	• C^4I	• Fused Data
	• Navy Technical and Research Labs	• All Encompassing Environmental Database

Surveillance Operations

Building upon the products developed from mapping, survey and intelligence operations, mine countermeasures-oriented surveillance operations must be initiated at the first sign of increasing tensions in a geographic region of interest. Surveillance assets and intelligence sources will be employed to obtain updated and increasingly detailed assessments of mine production and stockpile locations, minelaying platform locations, and readiness of a potential adversarial force as shown in Figure 3. Bottom mapping surveys and environmental data must be verified and updated to support initial planning of mine countermeasures operations to support possible joint force mission objectives.

National sensors, forward-deployed U.S. joint forces, including Special Operations Forces (SOF) and our allies all contribute to mine countermeasures surveillance operations.

Figure 3.

SURVEILLANCE OPERATIONS

ATTRIBUTES	ASSETS	PRODUCTS
• Intensify as Tensions Increase	• National Sensors	• Threat Mine Stockpiles
• Focus on Specific Region or Country of Interest	• Joint Forces - Airborne - Surface - Subsurface - Ground	• Adversary Minelaying Activities
• Build on Historic Database	• SOF	• Minelaying Platform Locations
	• C^4I	• Target ID for Strike
	• Allied and Coalition Forces	• Ship Movements & Routes
		• Fused Data
		• Potential Minefield Locations

Organic Mine Countermeasures Operations

The goal of organic mine countermeasures (MCM) operations is to provide deployed naval forces the ability to locate and clear mines without delay, understanding that volume clearance or neutralization will be conducted with the arrival of dedicated MCM forces.

Utilizing mapping, survey and intelligence databases — updated and detailed through surveillance operations — naval forces can initiate a variety of organic

mine countermeasures operations. These operations, as illustrated in Figure 4, will be performed in conjunction with the execution of their other warfighting missions to begin shaping the battlespace. Organic mine countermeasures operations include preemptive strike operations to interdict and destroy enemy mine stockpiles and minelaying platforms, mine reconnaissance by surface combatants and submarines using mine-reconnaissance systems and embarked combat swimmers, and limited mine-clearance operations by embarked Explosive Ordnance Disposal (EOD) divers. Although not an operation in itself, the use of acoustic and magnetic silencing to reduce the vulnerability of surface ships and submarines to mines is a passive form of organic mine countermeasures.

Information obtained through organic mine countermeasures will also be used to support the focusing of efforts of arriving dedicated mine countermeasures forces when such operations are necessary to further shape the battlespace.

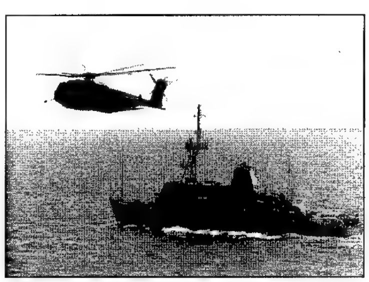
Figure 4.

ORGANIC MINE COUNTERMEASURES OPERATIONS

ATTRIBUTES	ASSETS	PRODUCTS
• Mine Recon Capability for Individual and Multi-ship Forces • Support Joint Force Risk Assessment • Support and Enable Joint Forces to Concentrate on Primary Mission • Hostile Environment	• Surface Combatants • Organic Aircraft • Subsurface Platforms and Combatants • Embarked EOD Dets • NSW • C^4I • Allied and Coalition Forces • Quieting and Degaussing	• Assess Threat • Risk Reduction to Transiting Forces • Focus Dedicated MCM Force Effort • Updated Databases • Mine Danger Areas/ Safe Routing • Transition to Dedicated MCM Operations

Dedicated Mine Countermeasures Operations

As tensions increase, dedicated mine countermeasures operations will capitalize upon and be focused by the results of MCM mapping, survey and intelligence operations, MCM surveillance operations, and organic MCM operations. Dedicated MCM operations are conducted to clear enemy minefields to further shape the battlespace and to project power from the sea.



Airborne, surface, and shallow water mine countermeasures forces, coupled with EOD divers, marine mammals and Navy Special Warfare (NSW) forces, will be used to conduct these dedicated operations.

These operations, depicted in Figure 5, must reduce the threat of mines (and obstacles) to permit operations within the sea lines of communications as well as within amphibious and operating areas key to the joint, allied, or coalition campaign.

Figure 5.

DEDICATED MINE COUNTERMEASURES OPERATIONS

ATTRIBUTES	ASSETS	PRODUCTS
• Sustained, Focused MCM Operations • Sustained Mine Clearance Operations • Capitalize on Results of Mapping, Survey, Intel, Surveillance and Organic MCM • Coordinated with Allied MCM Forces	• Air MCM Forces • Surface MCM Forces • USMC Forces • EOD • NSW • C^4I • Allied and Coalition Forces	• Reduced Threat of Mines and Obstacles to Acceptable Level • SLOC • NOA • AOA • Beach/CLZ • Other • Enable Sustained Naval and Joint Operations • Updated Databases

Supporting Infrastructures

To be a viable operational concept, this top-level Mine Countermeasures Concept of Operations depends upon the availability of supporting Command, Control, Communications, Computers and Intelligence (C^4I) and analysis programs, as illustrated in Figure 6.

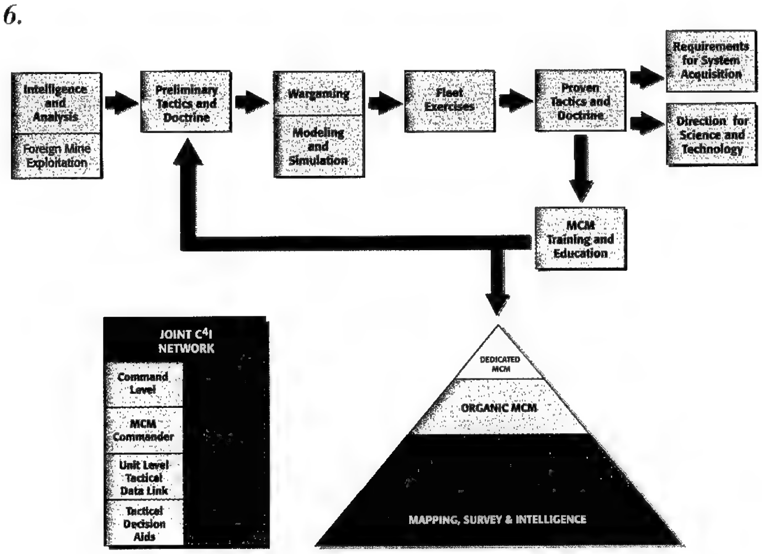
An aggressive fleet exercise program supported by modeling, simulation, and threat-based intelligence collection is essential to determining requirements for system acquisition, direction of science and technology efforts and to providing data for mine countermeasures training, education, and tactical development.

Mine Warfare forces require a functional C^4I network to provide both command and control connectivity between each level of mine countermeasures operations. Connectivity with U.S. joint forces and allied forces is also a must.

This Mine Countermeasures Concept of Operations requires support from all naval forces. Full implementation requires that naval forces be trained in mine countermeasures and that dedicated mine countermeasure forces be routinely

included in Fleet exercises. Mine countermeasures operations must become an integral part of naval force doctrine, education, and training.

Figure 6.



Architecture

In order to clearly show the approach to achieving the required mine warfare capability implicit in the Concept of Operations described earlier, a need exists for an underlying, unifying structure — a mine countermeasures architecture — that clearly delineates the functional relationships of the various components of the mine countermeasures systems that are in the fleet today and are under development. Such an architecture is essential for the purpose of communicating an understanding of the intricacies of the mine countermeasures problem and of the contributions and limitations of the individual platforms and systems.

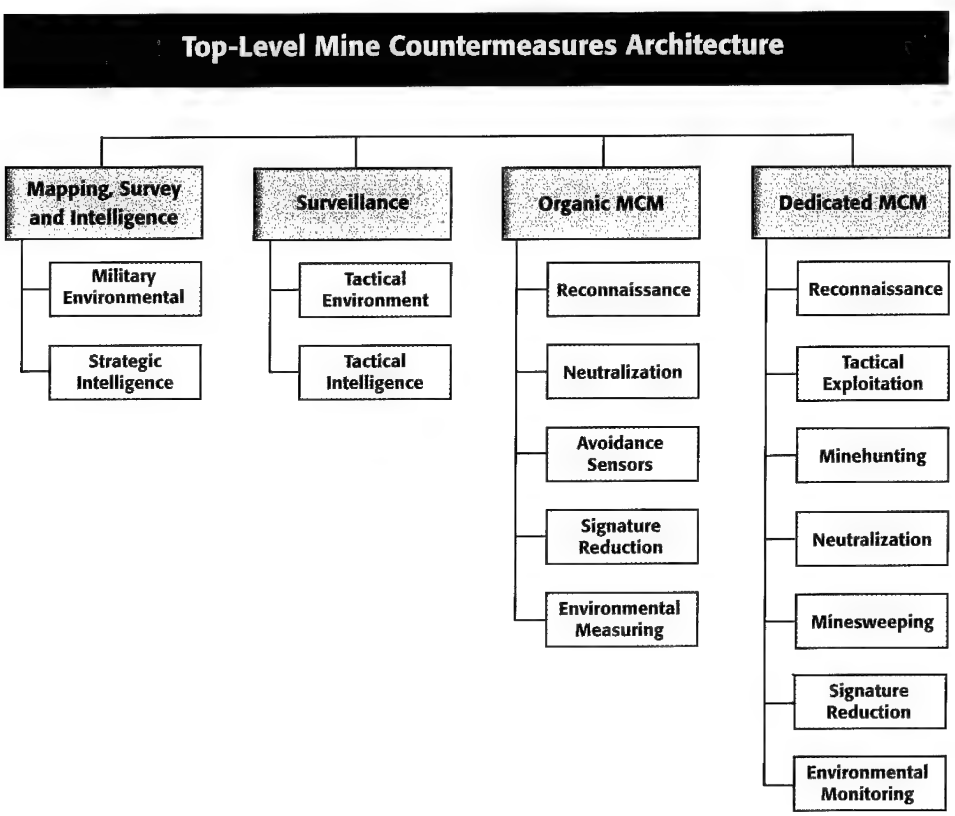
All of the pieces associated with the complex task of mine countermeasures must fit together in an integrated manner to achieve a unified mine countermeasures operational capability. Obviously, operational requirements drive the entire process.

Within this broad context, the mine countermeasures architecture provides the structure whereby the Concept of Operations is translated into supporting tasks and functions necessary for their implementation. The architecture thus forms the

unifying structure defining the conceptual employment of systems and equipments across each of the operational phases.

A top-level mine countermeasures architecture — associated with our Concept of Operations — is illustrated in Figure 7. The operational phases derived from the Concept of Operations are further broken down into a series of implementing functions to obtain a useful systems engineering-based structure. The functions then become the foundation within which existing and developmental capabilities and technologies can be mapped to form a complete, hierarchical picture of the total mine countermeasures systems approach. In addition, the mine countermeasures operational force components must be capable of effectively interfacing with all elements of the command structure and the joint task force elements through an effective C^4I interface. The C^4I capability thus becomes an underlying capability that permeates and unifies all of the operational phases.

Figure 7.



Allocation of Requirements and Systems

The primary benefit of a viable architecture is that it provides the necessary framework to clearly show which systems and equipment contribute to the accomplishment of the various functions. The MCM system components can thus be allocated across the functions.

An allocation of existing and developmental system components associated with each of the mine countermeasures operational phases are shown in a separate classified *Mine Warfare Plan* supplement. This allocation clearly shows where each of the various system components contribute to the overall capability of Naval forces. (A complete listing of current and developmental systems are contained in Appendices B and C. Abbreviations are defined in the glossary.)

The system architecture plays an important role in the articulation and understanding of mine countermeasures complexities. The architecture forms a unifying structure which identifies the operational and functional relationships of the various systems and equipment. The architecture also serves to illustrate a fundamental truth of mine countermeasures operations — that it is dependent upon a total systems approach rather than relying on any individual current or upcoming technology.

Shortfalls

While we have made great strides in addressing mine warfare concerns, our architecture is not complete. Currently, several key requirements are not being addressed by any in-service or developmental programs. Through the ongoing assessment process, funding for proposed solutions is to be accomplished either through redirection of current resources or identification as POM 98 (or beyond) issues. Shortfalls and solutions are summarized in the classified *Mine Warfare Plan* supplement.

MINING

Concept of Operations

Naval mining is clearly a force enhancer of tremendous potential. Our allies and adversaries recognize that mines are relatively low-cost weapons that can level the playing field between otherwise unequal opponents. To guarantee the effectiveness of our future efforts, we must integrate mining into the overall operational planning process, maintain an inventory of modern weapons, and ensure the availability of a variety of delivery platforms in sufficient numbers to execute approved plans.

The unique attributes of naval mines make them one of the most effective forms of naval warfare across the spectrum of conflict. Even the suggestion of the presence of mines in the water has deterred or delayed waterborne movement until the threat could be gauged effectively and neutralized. In the early stages of future crises, mines — not necessarily in large numbers — positioned either overtly or clandestinely, could be a strategic tool in convincing an adversary to reassess his intentions, contributing to the establishment of battlespace dominance. Therefore, mining can be effective across different levels of conflict, either as a stand-alone option or as an element in a broader response.

Our mining Concept of Operations describes the top-level operational roles of mining as a key component of our overall naval operational structure. There are three stages of mining operations within which all aspects of mining are grouped. They are the *planning*, *delivery*, and *campaign* stages.

The *planning* stage of the mining CONOPS includes the following basic activities:

- Determining mission requirements
- Identifying and planning priority minefields
- Developing, acquiring, and prepositioning mining assets
- Maintaining mine assets
- Exercising and training in the mining area
- Implementation of global mining alliances

Requisite to determination of mission requirements is threat assessment, collection of environmental and target data, and the development of algorithms for mine sensors. Effective minefield modeling is particularly important in this regard. The

development and acquisition of mines is an extremely important component of the "planning" phase, as is maintenance of a modern mine stockpile. Rigorous training and mining exercises are essential to ensure our readiness to conduct mining operations. Also important are the contributions of our allies. Many of them, including the United Kingdom, Italy, Germany, and Japan, have strong mine capabilities. The contributions available from our allies are included in our mining plans. Also, valuable mine design technology is available from our allies, and is obtainable through existing bilateral data exchange agreements and through NATO information exchange organizations.

The ability to *deliver* mines is central to our mining operations. Unlike our allies who rely chiefly on surface ship delivery, our primary delivery resource is the aircraft. Submarines can deliver certain mines (SLMM and CAPTOR), but the bulk of our mining effort is conducted by air. With an across-the-board reduction in numbers of these platforms, we must ensure that mine-delivery requirements are addressed in follow-on platforms.

The mining campaign stage may consist of four distinct missions:

- offensive mining
- defensive mining
- replenishment of minefields
- clearance of minefields

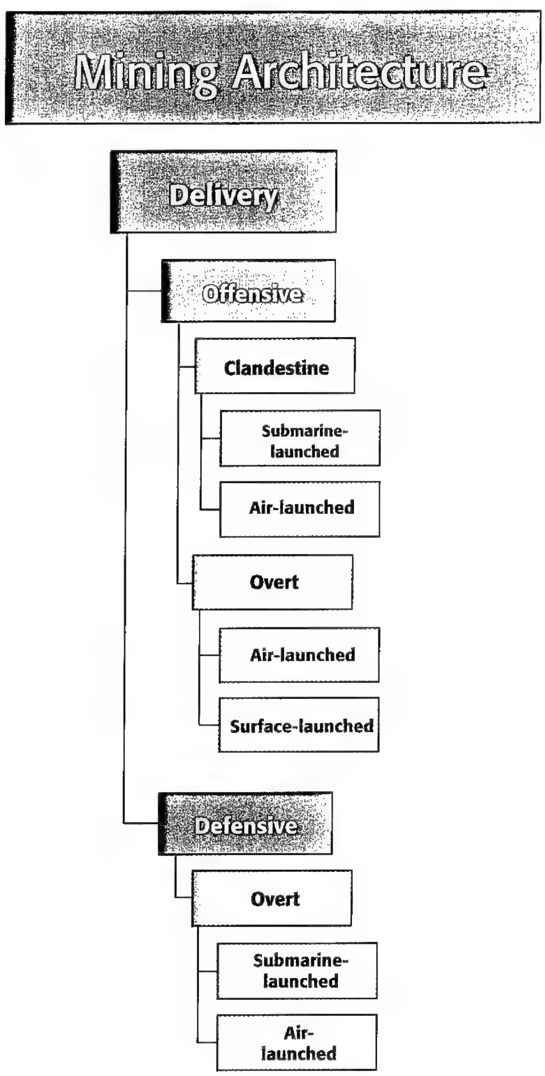
The Navy's future mining efforts in regional conflicts may be conducted in dramatically varying environments. Coastal bathymetries differ greatly, from shallow waters (around 150-foot depths in the Yellow Sea, for example) to deep waters (more than 6,000 feet in the Mediterranean). Continental shelf widths vary greatly as well, from broad shelves with gently sloping continental shelf-breaks to very narrow shelves with steep escarpments leading to deep basins just a few miles offshore.

Our mining CONOPS foresees a sequence of actions and responsibilities aligned to provide U.S. Naval Forces with an effective, responsive mining capability in order to deal with the challenges of the littoral environment.

Architecture

A mining architecture supports our CONOPS and is based on each of the operational phases. This architecture is presented in Figure 8. It will be reassessed based on current requirements, in-service capabilities, developmental programs, technology programs, international activities, and shortfalls.

Figure 8.



Requirements

Mining requirements are documented across each of the three phases of mining operations. Requirements have been developed not only for current mines, such as CAPTOR, but also for developmental mine programs as well and are presented in the classified *Mine Warfare Plan* supplement. Mine-delivery requirements are included in the development of top-level requirements for individual delivery platforms. Mission Needs Statements (MNS) for future development of an improved Submarine-Launched Mobile Mine (SLMM) and a Littoral Sea Mine (LSM) have been approved. A Mission Needs Statement for improved delivery methods is being generated. However, the mining requirement package largely in place today is representative of requirements developed in the Cold War era wherein deep-water, open-ocean mining was required vice shallower water, littoral mining scenarios currently faced by Naval forces. With this in mind, analyses are currently underway or planned to update/revise the existing mine requirements *vis-a-vis* post-Cold War military strategies and goals.

In-Service Capabilities

The Navy has a substantial in-service mine inventory consisting of Quickstrike bottom mines, the Mk 56 moored mine, the Mk 60 CAPTOR encapsulated torpedo mine, and the Mk 67 Submarine-Launched Mobile Mine. Each of these mines is described in detail in Appendix E of this plan. Commander, Mine Warfare Command, has in-place the organizational structure to provide minefield planning and operational maintenance and readiness of this in-service inventory. Additionally, a wide range of minelaying aircraft and submarine platforms are in service with the Navy and Air Force. On balance, the Navy has a highly effective in-service mine capability. Unfortunately, maintenance of these mines remains an issue due to the age of the inventory. For example, the Mk 56 moored mine represents 1950's technology, and even our most recent CAPTOR mines represent 1960's and '70's technology. Further, although completely approved for production, the latest Quickstrike target detection device, the TDD Mk 71, has not been procured.

Shortfalls

We thus have a large — but aging — inventory of mines. We need to take steps now to modernize the current inventory. Shortfalls of and solutions to our mining architecture are summarized in the classified *Mine Warfare Plan* supplement.

MINE WARFARE CAMPAIGN PLAN

Focus of Future Efforts

The mine threat that U.S. Naval Forces will face in the foreseeable future extends from the open ocean to the shallow waters of the world's coastal regions. But it is the latter *milieu* — the complex, littoral environment — that will determine the shape of much of our mine warfare programs and thinking in the years to come. We already have many systems and technologies in the Fleet that allow us to counter the threat from mines, even in littoral areas. For instance, U.S. Naval Forces have no equal in the area of ocean surveillance, processing capability, and battle force connectivity. Likewise, the professionalism and dedication of our forces are remarkable and excellent by any standard of comparison.

But some key elements remain deficient. An awareness of the need for mine warfare planning and training has not yet been institutionalized throughout the Navy and Marine Corps. There is also a need to address significant readiness and sustainability issues in the MCM force. And finally, hard decisions must be made to set programmatic priorities in order to correct capability shortfalls, and eliminate unnecessary and redundant overlap where it exists.

There is no single "silver bullet" that will solve our mine warfare shortfalls. A combination of existing systems and capabilities, coordinated with a prudent research and development effort, will be essential to keep the Navy and Marine Corps ahead of the mine threat. *There must be an integrated process*, one that adheres to an overarching plan and focuses on the delivery of vital MCM equipment, training, and information to the operators in the Fleet and Marine Force. Therefore, a Mine Warfare Campaign Plan is required to provide the plan and direction.

Building the Campaign Plan

The Mine Warfare Concept of Operations, provided earlier in this plan, presents the operational concepts that will guide the development of mine countermeasures doctrine, operations, tactics, and equipment. The accompanying Concept of Operations Architecture provided amplifying information on the employment of different systems.

Careful study of these documents reveals that we are still experiencing shortfalls in several areas. A flag-level Mine Warfare Steering Group headed by the

Director, Expeditionary Warfare (N85), is presently assessing these gaps in our capabilities. The Mine Warfare Campaign Plan that emerges from this effort will be the document that directs the resolution and timeline for closing these gaps. It will define what systems will be delivered to our operational units in the near term (FY 1996-1997), the mid-term (FY 1998-2002), and the long-term (FY 2003-2015). The Campaign Plan's prescriptions will be presented in the POM 1998 process.

The Campaign Plan will be rigorous but realistic. It will drive systems acquisition and science and technology to fill those capabilities needed by naval forces in the littorals.

APPENDICES

A. Mine Warfare Operational Organizations

B. Mine Countermeasures Platforms & Systems

Platforms

Surface Systems

Airborne Systems

Explosive Ordnance Disposal Systems

USMC Systems

C. Developmental Mine Countermeasures Programs

Surveillance Systems

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Explosive Ordnance Disposal Systems

USMC Systems

D. Mine Countermeasures Technology Initiatives

E. Naval Mines & Mine Delivery Platforms

Naval Mines

Mine Delivery Platforms

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H. Mine Warfare Meteorology & Oceanography (METOC) Programs

I. Glossary

Appendix A.

MINE WARFARE OPERATIONAL ORGANIZATIONS

The Mine Warfare Center of Excellence

Just as U.S. Armed Services are attempting full joint integration after a long period of loose coordination during the Cold War, elements of the Navy/Marine Corps Mine Warfare team are working toward near-term full integration at the Mine Warfare Center of Excellence, Ingleside, Texas. To date, the majority of MCM ships are based at, and conducting training out of, Ingleside, allowing increased attention to be paid to material readiness. Eventual collocation of the Mine Warfare Force, including all ships, aircraft, and training and support personnel is planned.

Commander, Mine Warfare Command

The Commander, Mine Warfare Command (COMINEWARCOM), located in Corpus Christi, Texas, was reorganized to better reflect increased emphasis on littoral warfare and amphibious operations as well as joint war-fighting and training initiatives. COMINEWARCOM has taken on additional duties as Commander, Naval Surface Group, Ingleside (COMNAVSURFGRU, Ingleside) reporting administratively to Commander, Naval Surface Forces, U.S. Atlantic Fleet (COMNAVSURFLANT).

Commander, Mobile Mine Assembly Group

As Administrative Commander of the worldwide Mobile Mine Assembly Group (MOMAG) units and detachments, COMOMAG oversees, as a single point of authority, all facets of the mine maintenance/assembly and final preparation effort, as well as mine exercise and training tasking, Naval Reserve (NR) MOMAG manning/readiness, and logistical/fiscal/administrative support for all MOMAG activities.

MOMAG's primary mission is to maintain the material readiness of Prepositioned War Reserve Mine Stockpile (PWRMS) of service mines and also to provide a reservoir of trained personnel organized in Mobile Units, capable of rapid deployment for final mine preparations of mine stocks to support mining operations. MOMAG also maintains the material readiness of CINCPACFLT, CINCLANTFLT, COMUSNAVCENT, and CINCUSNAVEUR Mine Warfare exer-

cise and training assets as directed by COMINEWARCOM. Additionally, COMOMAG has responsibility for mine readiness issues.

COMOMAG reports administratively and operationally to COMINEWARCOM and reports for additional duty to the Naval Ordnance Center, Indian Head, Maryland.

MOMAG Units and Detachments are positioned worldwide at Seal Beach, California; Earle, New Jersey, Sigonella, Sicily; Barbers Point, Hawaii; Guam; Okinawa; Charleston, South Carolina; Misawa, Japan; Yorktown, Virginia; and Kingsville, Texas.

MOMAG ensures uniformity of mine maintenance practices, standardization of quality-assurance procedures, and standardized inventory management and mine assembly flow for fleet CINCs. Consolidation of mine sites under MOMAG has resulted in the Mine Force becoming one of the most cost-effective, reliable and responsive organizations in the ordnance community.

Helicopter Mine Countermeasure Squadrons Fourteen & Fifteen

In 1994, the last of 48 planned MH-53E aircraft were delivered to the active and reserve naval forces; the Mine Warfare Force then transferred the last of the Naval Reserve Force's MCM-modified RH-53Ds to the Marine Corps. The accomplishment of this milestone ensured, for the first time, that all airborne mine countermeasures forces are outfitted with the most sophisticated and capable AMCM weapons system platform in the world. Currently, there are two operational HM squadrons.

As a result of recent MCM force restructuring, the two former Reserve Helicopter MCM Squadrons (HM-18 and HM-19) were disestablished and became fully integrated with their counterpart active squadrons HM-14 (Norfolk, Virginia) and HM-15 (Alameda, California). HM-15 will relocate to NAS Corpus Christi, Texas in 1996. Each active squadron now has 12 aircraft; six for active-duty operations, and six for Reserve Force training, with two of the training aircraft ready for short notice deployments with their active duty counterparts.

In another action to consolidate similar flight training, HM-12, which previously provided specialized flight training for MH-53E pilots and crewmembers, was also disestablished. Navy and Marine Corps advanced flight training for H-53 series helicopters is now conducted at a single site by the Marine Corps. The remainder of the MH-53E helicopters have been transferred to the Marines for training or for use in heavy-lift combat support roles in the Mediterranean.

Fleet Mine Warfare Training Center

Consolidation of mine warfare forces also provided a unique opportunity to combine the visionary ideas of COMINEWARCOM and Commander, Training Force Atlantic (COMTRALANT) in the first of a new generation of warfare support centers: the Fleet Mine Warfare Center (FMWC). Scheduled to open in March 1996, FMWC will provide all manner of mine warfare tactical, doctrinal, and technical information and training. Housing proficient mine warriors fresh from fleet experience, the Center will also be home to an Afloat Training Group (ATG). The ATG will eliminate lock-step training driven by certification goals and implement a continuous, ship-wide training cycle. This will allow training packages to be custom-tailored to individual ship's needs and ensure a consistent level of shipwide readiness. The FMWC staff will teach a new, expanded sequence of Mine Warfare courses. Officer and senior enlisted pipeline training will be built around a three-week curriculum providing theoretical and technical foundations of mine warfare. Training will prepare students for more advanced, three-week mine and MCM systems and tactics courses. The collocation of FMWC with its primary constituency will minimize temporary duty and travel costs, while maximizing accessibility.

The Center will also be linked on-line through local and wide area computer networks including a gateway to the Internet. These technologies will allow the Fleet Mine Warfare Center to support the mine force locally as well as to reach worldwide to support virtually anyone requiring the Center's information products and services. In addition, a training range requirements study has been completed, and we have developed an instrumentation package and a tracking system that has been successfully demonstrated in a fleet exercise.

Naval Special Warfare

A clandestine Naval Special Warfare (NSW), very shallow water (VSW) MCM capability has remained limited to that of the combat swimmer since World War II. NSW doctrine requires combat ready deployable platoons be fully qualified to conduct hydrographic reconnaissance from the 3 1/2 fathom curve (21 feet) to the high water line. Mine detection is considered a subset of this capability. As combat swimmers, NSW forces maintain the capability to conduct hydrographic reconnaissance and obstacle detection, but are limited in their ability to detect mines. Technology currently limits NSW forces to detecting proud mines.

The role for combat swimmers will never completely go away. Even with the introduction of sophisticated new technologies, combat swimmers will be necessary for a variety of mine warfare missions, such as the verification of mine neutralization.

However, new systems will significantly increase the success rate of mine detection while simultaneously assuring a greater margin of safety to combat swimmers.

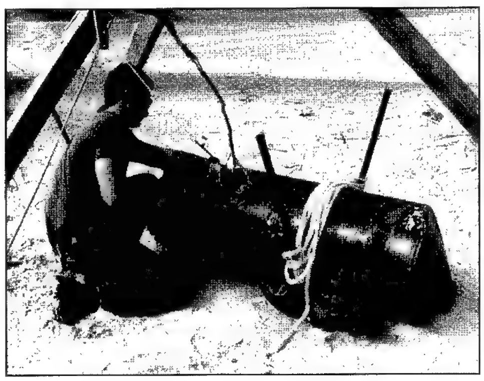
U.S. Marine Corps Engineers

The role of the Marine Air-Ground Task Force (MAGTF) combat engineer is to retain/improve the force's freedom of movement, reduce enemy freedom of movement, lessen the effect of enemy weaponry and the environment on the force, and sustain the efforts of the force elements in carrying out the commander's plans. In fulfilling these roles, engineers carry out missions related to mobility, counter-mobility, survivability, and general engineering. Engineer units are organic to each of the major subordinate elements of the MAGTF. Engineer assets organic to the ground combat element (GCE) are drawn from the combat engineer battalion (CEB) of the Marine division. 1st Combat Engineer Battalion supports the 1st Marine Division (Camp Pendleton, California) and the 2nd Combat Engineer Battalion supports the 2nd Marine Division (Camp Lejeune, North Carolina). Each of these battalions consists of a Headquarters and Service Company, one Engineer Support Company, and four Combat Engineer Companies. The 3rd Marine Division is supported by a unique five-platoon, Combat Engineer Company as part of the Division's Combat Assault Battalion.

Combat engineers can change the dimension of the battlefield. The Combat Engineer Battalion provides support that enhances the ground combat element's ability to locate, close with, and destroy the enemy. An amphibious operation can produce unique breaching and obstacle reduction problems for the MAGTF. Establishing and rapidly building combat power ashore requires breaching obstacles integrated into the shoreline defense. Planning, organizing, and coordinating the assault breaching of explosive and non-explosive obstacles from the high water-mark inland is a primary responsibility of the Combat Engineer Battalion. Initially, combat engineer involvement during amphibious landings focuses on mobility. This support will typically consist of combat engineers organized into breaching teams accompanying the first waves ashore. As the landing beaches are cleared of hostile fire, the engineer's heavy equipment can be landed and a more deliberate obstacle reduction effort can begin. This effort assists the landing of armored vehicles, artillery, and motor transport assets. These efforts are followed by more deliberate engineer efforts, normally performed by engineers of the Combat Service Support Element in support of the landing force support party as it begins organizing the beach.

Explosive Ordnance Disposal

The Navy's EOD force is organized at three levels: EOD Groups (EODGRUs), EOD Mobile Units (EODMUs), and various types of EOD Detachments (EOD DETS). There are two EODGRUs: EODGRU ONE at San Diego, California (Naval Amphibious Base Coronado), and EODGRU TWO at Norfolk, Virginia (Naval Amphibious Base Little Creek). EODGRU ONE reports to the Commander, Naval Surface Forces Pacific; EODGRU TWO, to the Commander, Naval Surface Forces Atlantic. Each EODGRU has readiness responsibility for several subordinate EODMUs, which in turn have readiness responsibilities for numerous shore EOD DETS and deployable mine countermeasures detachments (MCM EOD DETS), multi-mission detachments (MOB EOD DETS), and Marine Mammal System detachments (MMS DETS).



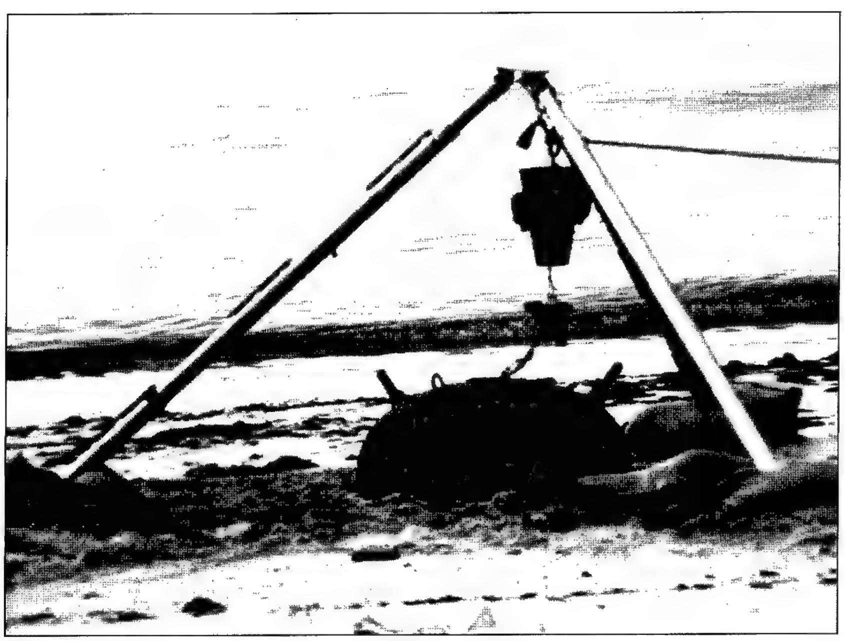
Among the deployable EOD MCM forces are 15 MCM EOD DETS and three of the four MMS EOD DETS that specialize in mine warfare capabilities in support of the Commander, Mine Warfare Command. EODMU SIX, headquartered in Charleston, South Carolina, is responsible for the readiness of six of the 15 EOD MCM DETS — four homeported in Charleston and two in Ingleside, TX. The remaining 9 MCM EOD DETS are dispersed globally for support of theater commanders and the Commander, Mine Warfare Command. Three of these are homeported overseas (two in Sigonella, Sicily, and one in Guam) to facilitate continued interaction with allied counterparts through combined exercises.

Regardless of homeport, all MCM EOD DETS can deploy as organic elements of the Navy's MCM squadrons, either on an MCM command and control ship or another designated ship. These DETS provide EOD support for the squadron commander's SMCM ships, AMCM helicopters, and MMS DETS. The two MCM EOD DETS homeported in Ingleside serve to develop tactics for integrated training and operations tactics with collocated MCM commands.

EOD MCM DETS and MMS DETS support minehunting and mine-clearance

operations. These DETS are outfitted and trained to locate, identify, neutralize, recover, conduct field exploitation, and dispose of sea mines, torpedoes, and depth charges. They work closely with other Navy MCM forces in order to provide trained and ready forces for response to worldwide mine crises.

Aside from the specialized Mine Warfare EOD forces discussed above, MOB EOD DETS, which routinely deploy in carrier battle groups and amphibious ready groups, possess partial capabilities in mine warfare, providing a limited organic MCM capability to dispose of drifting and moored mines encountered by the task groups at sea. Finally, Naval Reserve EOD Mobile Units provide Mobile Communications Detachments (MCD), Ordnance Clearance Detachments (OCD), and Area Search Detachments (ASD) that serve as force multipliers and enhance the capabilities and sustainability of active EOD forces and other operational commanders.

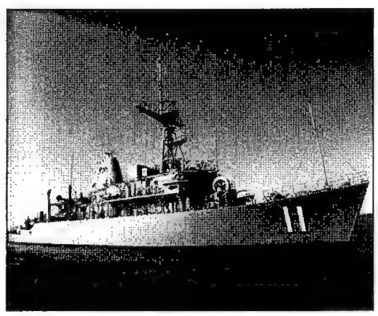


Appendix B.

MCM PLATFORMS & SYSTEMS

Platforms

Avenger (MCM-1) Mine Countermeasures Ships



The 14 ships of this class are relatively large mine countermeasures ships intended to locate and destroy mines. They are deployed to coastal waters, choke points, and critical overseas areas. The basic MCM design is similar to previous MSO (Ocean Minesweeper) classes. The hull is constructed of fiberglass-sheathed wood (laminated oak framing, Douglas fir planking and deck sheathing with reinforced fiberglass covering). These materials, combined with low-perm ferrous metal throughout and a sophisticated automatic degaussing system, enable this class to possess and maintain a low magnetic signature. Various acoustic quieting measures, including resilient engine mountings, give these ships a low acoustic signature. One or two AN/SLQ-48 Mine Neutralization System (MNS) vehicles are carried in addition to conventional sweep gear. The ships are fitted with the AN/SSN-2 Precise Navigation System. The MCMs were initially fitted with the AN/SQQ-30 variable-depth sonar. This equipment has been superseded in later ships by the AN/SQQ-32. All ships have four very-low magnetic signature diesel engines for propulsion and are equipped with a quiet, low-speed electrical propulsion system for minehunting. A 350-hp bow thruster is also fitted for precise maneuvering. Maximum minehunting speed is five knots.

The lead unit of the class, *Avenger*, was ordered on 29 June 1982 and laid down on 3 June 1983; the first large minesweeper under construction for the U.S. Navy since the USS *Assurance* (MSO-521) was completed 25 years earlier. Under the original plans, after approximately one year in active service, the first eight units were to join the Naval Reserve Force (NRF) to replace the aging *Agile* and *Aggressive* classes. *Avenger* was scheduled to enter the NRF on 30 September 1989. In 1989 the Navy decided to keep all 14 ships of the class in the active fleet. However, the current plan is for 10 active and 4 reserve ships. Two ships trans-

ferred to the NRF in FY 95; planning currently calls for two more ships to transfer in FY 96. The final three ships of the class were requested under the FY 90 program. Both *Avenger* and *Guardian* supported the Multinational Coalition MCM efforts during Operations Desert Shield/Desert Storm.

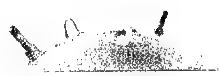
Characteristics

Displacement	**1,312 tons full load**
Dimensions	
length	**212 ft 9 in waterline**
	224 ft 3 in overall
beam	**39 ft**
draft	**12 ft 2 in**
Propulsion	**MCMs 1,2 4 diesels (Waukesha L-1616)**
	2,280 bhp; 2 shafts
	MCMs 3-14 4 diesels (Isotta-Fraschini ID36 SS-6V-AM)
	2,600 bhp; 2 shafts
Speed	**13.5 kts**
Manning	**83 (8 Off + 75 Enl)**
Combat Systems	
guns	**2. 50 caliber machine guns**
radars	**AN/SPS-55/SPS-66 surface search**
sonars	**AN/SQQ-30 mine detecting in MCM 2-9**
	AN/SQQ-32 mine detecting in MCM 1, 10-14 (retrofit in MCM 2-9)
sweeps	**AN/SLQ-38 mechanical sweep system**
	AN/SLQ-37 magnetic/acoustic influence sweep system
Mine Neutralization System	**AN/SLQ-48 mine neutralization system**
Precise Navigation System	**AN/SSN-2 navigation/command control system**

Number	Name	FY	Launched	Commissioned
MCM-1	*Avenger*	82	15 Jun 1985	12 Sep 1987
MCM-2	*Defender*	83	04 Apr 1987	30 Sep 1989
MCM-3	*Sentry*	84	20 Sep 1986	02 Sep 1989
MCM-4	*Champion*	84	13 Apr 1989	27 July 1991
MCM-5	*Guardian*	84	20 Jun 1987	16 Dec 1989
MCM-6	*Devastator*	85	11 Jun 1988	06 Oct 1990
MCM-7	*Patriot*	85	15 May 1990	13 Dec 1991
MCM-8	*Scout*	85	20 May 1989	15 Dec 1990
MCM-9	*Pioneer*	85	25 Aug 1990	07 Dec 1992
MCM-10	*Warrior*	86	08 Dec 1990	03 Apr 1993
MCM-11	*Gladiator*	86	29 Jun 1991	18 Sep 1993
MCM-12	*Ardent*	90	16 Nov 1991	18 Feb 1994
MCM-13	*Dexterous*	90	20 Jun 1992	09 Jul 1994
MCM-14	*Chief*	90	12 Jun 1993	05 Nov 1994

Osprey (MHC-51) Minehunters

The 12 units of this coastal minehunter class are based on the Italian-designed Lerici class mine countermeasures vessel (MCMV). The ships have Glass-Reinforced Plastic (GRP) monohull single skin structures and are equipped with the AN/SLQ-48 mine neutralization system and the AN/SQQ-32 minehunting sonar. Mechanical minesweeping systems are being developed independently. The ships are capable of coastal mine clearance operations for up to 15 days without replenishment. The *Osprey* class is a scaled-up version of the original Lerici design, with a full load displacement of 915 tons — vice the 540 tons of the Italian craft — and heavier minesweeping equipment.



In August 1986, a contract was issued to Intermarine USA (established by Intermarine Sarzana of Italy, builders of the original Lerici design) to study possible adaptations of the Lerici MCMV to carry U.S. combat systems and electronics. Intermarine was awarded the contract on 23 May 1987 to construct the lead ship. On 17 February 1989, Intermarine was awarded a $55.3-million contract to build MHC-52. The Italian GRP technology was transferred to Intermarine USA, and to the second-source U.S. shipbuilder, Avondale Industries. Eleven of the 12 MHC-51 class ships will transition to the NRF one year following their respective commissioning dates.

Characteristics

Displacement	**915 tons full load**
Dimensions	
length	**188 ft overall**
beam	**35 ft 11 in**
draft	**9 ft 6 in**
height	**66 ft**
Propulsion	**2 diesels (Isotta-Fraschini ID 36 SS 8V-AM); 1,600 bhp;**
	2 shafts
	2 Voith-Schneider cycloidal propellers
Performance	
speed	**15 kts**
range	**1,500 nm at 10 kts**
Manning	**51 (5 Off + 46 Enl)**
Combat Systems	
guns	**2 .50 caliber machine guns**
radars	**AN/SPS-64(V)9 surface search**
sonar	**AN/SQQ-32 mine detecting**
Mine Neutralization System	**AN/SLQ-48 mine neutralization system**
Precise Navigation System	**AN/SYQ-13 navigation/command control system**

Number	Name	FY	Launched	Commissioned
MHC-51	*Osprey*	86	23 Mar 1991	20 Nov 1993
MHC-52	*Heron*	89	20 Mar 1992	06 Aug 1994
MHC-53	*Pelican*	89	27 Feb 1993	18 Nov 1995
MHC-54	*Robin*	90	11 Sep 1993	
MHC-55	*Oriole*	91	22 May 1993	16 Sep 1995
MHC-56	*Kingfisher*	91	18 Jun 1994	
MHC-57	*Cormorant*	91	21 Oct 1995	
MHC-58	*Blackhawk*	92	27 Aug 1994	
MHC-59	*Falcon*	92	03 Jun 1995	
MHC-60	*Cardinal*	92		
MHC-61	*Raven*	92		
MHC-62	*Shrike*	93		

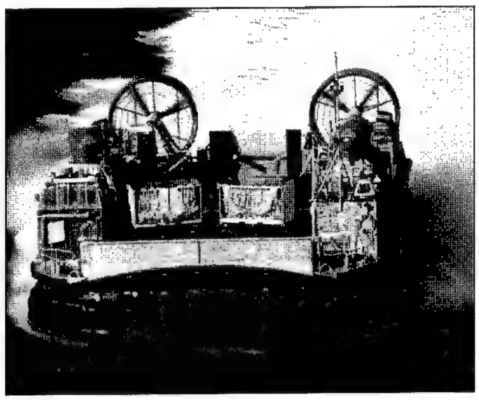
MCS-12 Mine Countermeasures Command, Control and Support Ship (MCS)

The USS *Inchon* (LPH-12) began a major conversion to MCS-12 on 6 March 1995, to provide her with MCS-unique capabilities to perform a wide range of AMCM, SMCM, and EOD MCM support roles worldwide. The MCS will have modern state-of-the-art C^4I systems and provide full mission planning, and execution and evaluation capabilities to support an MCM Squadron Commander and staff. Additionally, the MCS will provide an operating base with maintenance and logistics support for AMCM/EOD MCM detachments, and SMCM ships alongside. This integral intermediate-level repair capability will add a new dimension of sustainability to MCM readiness. An NRF ship, *Inchon* will be manned by a crew of active and reserve personnel.

Multi-Mission Craft, Air Cushioned (MCAC)

The MCAC program modifies Landing Craft, Air Cushion (LCAC) vehicles to conduct a variety of missions. With certain conversions, the MCAC is capable of employing MCM equipment to hunt and sweep mines. MCAC conversions have been completed on 10 LCACs to date and will be included in all remaining LCACs to come off the production line (10 additional craft). The MCAC has also been designated as the delivery platform for the SABRE and DET developmental breaching systems. To minimize danger to personnel during mine clearance operations in the

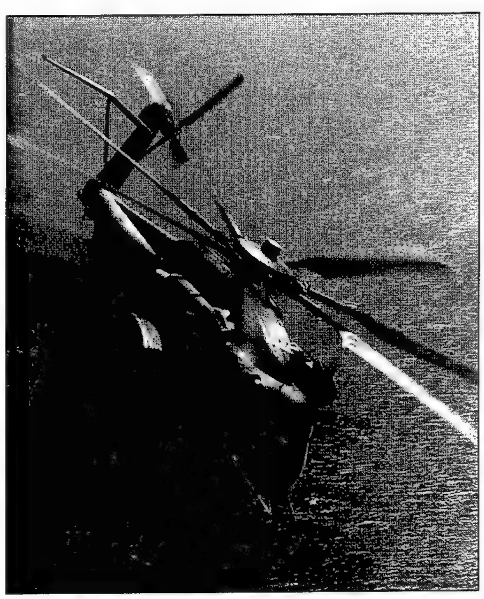
surf zone, the MCAC will eventually be remotely controlled.



In addition to MCM operations, MCACs will be able to perform other missions such as transporting troops and supplies from ship to shore, medical evacuation, and other tactical and logistical functions in support of amphibious operations. Systems integration and testing has been completed, and MCM Kit #1 has been successfully tested at the Coastal Systems Station, Panama City, FL. MCAC crews have been trained and successfully operated MCACs in an MCM mode for the first time during exercise Kernal Blitz 95.

MH-53E Sea Dragon Helicopter

The E-model of the H-53 is the heaviest-lift helicopter in service in the West, with the MH-53E Sea Dragon being a minesweeping variant with larger fuel capacity than the CH-53E series. The MH-53E series is similar to the earlier CH-53A/D Sea Stallion helicopters in U.S. Navy and Marine Corps service. The airframe follows the pattern of the earlier RH-53D versions, having an unobstructed cabin with lowering rear ramp behind a blunt nose and flight deck and under the power train. The cabin is spacious enough to accept seven pallets measuring 3 ft 4 in x 4 ft; seating for 55 troops or space for 24 litters is also provided. A single-point cargo hook below the fuselage can carry an 18-U.S. ton (16.5-metric ton) sling load although 16 tons (14.5 metric tons) is more typical.



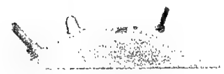
The MH-53E Sea Dragon is a U.S. Navy multi-purpose aircraft employed for vertical replenishment and Airborne Mine Countermeasures (AMCM) operations. In the latter role it can tow a variety of sweep gear,

including the Mk 103 mechanical minesweeping gear, Mk 104 acoustic countermeasures, Mk 105/106 magnetic/ magnetic-acoustic MCM hydrofoil sled, the AN/SPU-1 Magnetic Orange Pipe (MOP) for countering shallow-water mines, the AQS-14 sidescan sonar, and the ALQ-141 mine countermeasures system. Greatly enlarged fuel sponsons are made from composite materials with a total capacity of 3,212 gal (12,112 liters). The aircraft is also fitted with a retractable inflight refueling probe. The MH-53E has a four-hour mission capability (plus reserves) and is capable of all-weather day/night flying, but not night time MCM operations.

The first flight of the MH-53E variant was on 1 September 1983, with the first delivery to a U.S. Navy squadron (HM-12), on 1 April 1987. The first delivery of the S-80-M-1 export version of the MH-53E was made to the Japan Self Defense Force in January 1989.

The tow boom is capable of 30,000 lb tow tension load. Maximum useful load for influence minesweeping mission is 26,000 lb (11,793 kg). The aircraft is fitted with Hamilton-Standard AFCS, Doppler, OMEGA navigation systems and a GPS minesweeping navigation system. All MH-53Es are slated to receive a mission-planning computer system during the mid-1990s.

The biggest change from the earlier RH-53D versions is in the power train. A third T64 turboshaft engine is fitted behind the main rotor mast; it is fed by an intake located to the left of the rotor mast. The main transmission gearbox, located directly below the main rotor hub, is linked to the three engines by drive shafts that extend forward and outward to the outboard engines and to the rear for the third engine. To absorb the increased power, a seventh blade was added to the fully articulated, titanium-and-steel main rotor hub. Each blade has a wider chord and greater length, a titanium spar, Nomex core, and fiberglass-epoxy skinning. The seven blades are power-folded. The tail section was altered several times during development, with the final arrangement having the tail rotor pylon canted 20 degrees off vertical to port; the large four-blade tail rotor is fitted at the top. A long, strut-braced gull-wing horizontal stabilizer extends to starboard. The tail pylon power-folds to starboard, reducing overall height by 9 ft 9 in. Flight control is maintained by a Hamilton-Standard FCC-105 Automatic Flight Control System (AFCS) with four-axis autopilot and two digital computers. On either side of the fuselage are large fuel sponsons; the main gear units fold into the rear of the sponsons, and the nose gear folds forward.



Characteristics

Manufacturer	**Sikorsky Aircraft Co., Stratford, Conn.**
Crew	**3 (2 pilots, 1 crew chief) + MCM personnel**
Engines	**3 General Electric T64-GE-416 turboshaft**
max power	**4,380 shaft hp each (10 minutes)**
total power	**13,140 shaft hp**
Fuel	**3,212 gal (internal)**
Weights	
empty	**36,336 lb**
***max payload* – internal**	**33,414 lb**
sling load	**37,164 lb**
max tow tension	**30,000 lb**
useful load	**26,000 lb**
Dimensions	
***length* – fuselage**	**73 ft 4 in**
overall	**99 ft 1/2 in**
folded	**60 ft 6 in**
***height* – overall**	**29 ft 5 in**
folded	**18 ft 7 in**
***width* – overall**	**18 ft 7 in**
folded	**27 ft 7 in**
***cabin* – length**	**30 ft 0 in**
width	**7 ft 6 in**
height	**6 ft 6 in**
disc area	**4,902 sq ft**
rotor diam	**79 ft 0 in**
Performance (at 56,000 lbs)	
max speed	**170 kts**
cruise	**150 kts**
climb rate	**2,500 ft/min**
ceiling	
service	**18,500 ft**
hovering	**11,500 ft in ground effect**
	9,500 ft out of ground effect
range	**approx 450 nm with 20,000 lb payload, without inflight refueling**
self-ferry	**1,000 nm**

Surface Systems

AN/SQQ-30

The AN/SQQ-30 is an upgraded mine detection and classification sonar developed from the AN/SQQ-14 (originally named the Deep Mod AN/SQQ-14). The SQQ-30 entered Navy service in 1983 and is fitted on the *Avenger* class ships (MCM 2-9). Like the Deep Mod SQQ-14, it is cable-lowered from under the minesweeper, but can be operated at greater depths and handled more easily. Other improvements include:

- A long tow cable/conductor replaced the articulated strut of the original SQQ-14 to enable greater search depths
- An electronically stabilized sonar dome is used instead of the tension stress of the articulated strut in the SQQ-14s
- An increased vertical coverage capability is added to the sonar transducer
- The sonar dome is strengthened to withstand greater depths

  The SQQ-30 will be succeeded in service by the AN/SQQ-32 and backfitted into MCM 2-9.

AN/SQQ-32

The AN/SQQ-32 is a variable-depth mine detection and classification sonar. A developmental model was installed on MCM-1 and beginning with MCM-10 the SQQ-32 became the standard sonar for this class, in place of the AN/SQQ-30. The SQQ-32 is standard on all of the MHC-51 class and is being backfitted in MCM 2-9. It has better detection and classification ranges than the SQQ-30, is better at discriminating between genuine mines and other objects, and is able to identify objects with near-picture quality. The SQQ-32 displays search and classification information simultaneously and independently, using separate search and classification transducers in a stable, variable-depth body. Multi-beam operation increases the sonar's search rate. The SQQ-32 can also be used from the hull in shallow water. Initial operational capability was in 1989. A prototype SQQ-32 was deployed to the Persian Gulf during Operations Desert Shield/Desert Storm on the USS *Avenger* (MCM-1).

AN/SLQ-37 Magnetic/Acoustic Influence Minesweeping System

Installed in the *Avenger* (MCM-1) class ships, the SLQ-37 consists of a straight tail magnetic sweep (M Mk 5A) combined with the earlier A Mk 4(V) and/or A Mk 6(B) acoustic sweeps. The system can be configured in several ways, including diverting the magnetic cable and/or the acoustic devices by using components from the AN/SLQ-38 mechanical gear. Detailed information on each of these devices is provided below:

M Mk 5

The most common magnetic sweep available to the U.S. Navy Surface Forces is the straight tail, two electrode M Mk 5(A). This WW II-type sweep can also be diverted to one side using either electrode to complete the electric circuit through the water or in a closed loop concept whereby the distance between the electrode attachment points is closed by an insulated length of heavy cable. The different configurations possible with this versatile sweep provide the MCM commander with a variety of choices which depend on the environmental conditions, the type of mine weapon being swept, and the safety of the sweeper platform. Electric current through the minesweeping cable itself produces magnetic fields in accordance with the right-hand rule of magnetic theory. With an electrode sweep, the currents passing through the sea water also generate magnetic fields which, with the correct environmental conditions, can greatly increase the area being covered by the magnetic sweep field. Although only the large size (S3/Q3 cable) magnetic sweeps are used by the MCM-1 class, smaller versions have been used by smaller ships and minesweeping boats and launches in the past. All operate on the same principles.

The basic M Mk 5(A) sweep cables can also be used in a two-ship version (the M Mk 4 sweeps) and as a static sweep for confined areas (M Mk 3 sweeps) whereby the ship remains stationary and the magnetic tail is moved around by small boats. Also available for precursor or shallow water sweeping is the surface ship version of the SPU 1W MOP, a 30 ft steel pipe capped at both ends and filled with styrofoam. The MOP is "permed" or remagnetized before each mission.

A Mk 4(V)

The A Mk 4(V) is a towed acoustic sweep hammer box used on MCM-1 class mine countermeasures ships. It is a carry-over from WW II that consists of an electrically driven hammer in a streamlined housing striking a steel diaphragm — similar in concept to the jackhammers used to break up concrete. The A Mk 4(V) acoustic

sweep output covers the medium frequencies. The sweep is normally suspended from a minesweeping float and towed 1,200 yards astern of the sweeper.

A Mk 6(B)

Another holdover from WW II is the standard U.S. Navy low-frequency acoustic sweep, the A Mk 6(B). The A Mk 6(B) generates acoustic sweep energy by means of a diaphragm driven by pistons connected to an electric motor through an eccentric mechanism. The sweep is normally suspended from a minesweeping float and towed 1,200 yards astern.

AN/SLQ-38

The newest design based on the venerable Oropesa sweep, the SLQ-38 is rugged, stable, and effective. It can be rigged to one or both sides of the hull and can be used with another ship in a catenary fashion. The sweep is standard equipment on the MCM-1 class.

AN/SLQ-48(V) Mine Neutralization System

The SLQ-48 Mine Neutralization System (MNS), an unmanned minehunting submersible, is intended for both the MCM-1 and MHC-51 classes. The vehicle takes its power and guidance commands from the launching ship through an umbilical cable. After the target is detected and classified by the ship's sonar, the remotely operated vehicle, initially directed by ship's sonar data, proceeds to the target at speeds of up to 6 knots. The vehicle carries a small high-definition sonar and an acoustic transponder that enables the vehicle to be tracked by the shipboard sonar. There is also a low-light-level television for examining the target, with illumination provided by an onboard floodlight. Propulsion is provided by two 15-hp motors and there are two horizontal and two vertical thrusters for exact positioning above a target. The umbilical cable length is 3,500 feet. Two consoles on board the ship monitor and control the vehicle's operation. The MNS can destroy bottom mines by placing an explosive charge near the mine or cut the cable of moored mines causing them to rise to the surface for subsequent neutralization or exploitation. A new capability to destroy moored mines in-place is under development as a pre-planned product improvement.

AN/SLQ-48 (V) Characteristics

Weight	**2,700 lb**
Length	**144.5 in**
Width	**36 in**

Kingfisher Sonar System

The KINGFISHER sonar system modification effort was initiated following the mining of the USS *Samuel B. Roberts* in the Arabian Gulf in April 1988. The term "KINGFISHER" refers to the modification to the AN/SQS-56(M), AN/SQS-53(A/B) and AN/SQS-56C sonar systems that provides the ship with an organic, hull-mounted, mine-like object detection and avoidance capability. KINGFISHER is currently installed as a permanent modification to some ships as well as a cross-deck system for others. Long-term plans for KINGFISHER call for permanent installation of the modification on 79 ships.

Mechanical/Oropesa (Wire) Sweeps

The Oropesa (O) wire sweeps are of various types, all of which are designed to deal with moored buoyant mines relatively close to the surface. The O Size 1 is the largest wire sweep for MCMs; when streamed with 300-fathom wires at a maximum speed of about 8 knots (sweep depth of 5-40 fathoms), the swept path for a double sweep is 500 yards wide (250 yards for a single sweep).

M Mk 6

The M Mk 6 electromagnetic sweeps are of various types: M Mk 6(a) is called a "J-sweep," with the long legs curving around to meet a diverted line towed by the ship and connected to an Oropesa (wire sweep) and a kite; M Mk 6(b) is a single-ship closed-loop sweep, using Oropesa floats to keep the legs apart; and M Mk 6(h), a closed-loop sweep with two legs meeting at a diverter line streamed from an Oropesa.

AN/SSQ-94-T1 Combat System Integrated Trainer

The SSQ-94 system provides MCM-1 and MHC-51 class ships with computer-driven, onboard combat systems training in navigation, command and control, mine detection, and classification and neutralization, for individual operators, sub-teams, and full combat system teams. The system provides an organic training capability for MCM-1 and MHC-51 class ships, either in port or underway, in order to improve and maintain mission readiness of individual ships.

AN/SSN-2(V)4 Precise Integrated Navigation System (PINS)

The Precise Integrated Navigation System (PINS) is an integrated, GPS-based, computer navigation system that provides positional data to command and control displays. The system uses standard commercial peripherals, Navy computers and proven MCM dedicated tactical display consoles. The system also provides MCM-1-class ships with continuous precision tracking using an integrated acoustic tracker in support of SMCM operations.

AN/SYQ-13 Navigation/Command and Control System

The AN/SYQ-13 Nav/C^2 system integrates the combat system and displays tactical information to assist the Commanding Officer and Tactical Action Officer in planning and execution of operations on MHC-51 class ships. The system integrates data from navigation systems with the ship's Doppler speed log and gyrocompass input to compute ownship position with the precision necessary for minehunting. It interfaces with the surface search radar and SQQ-32 sonar providing real-time updates and display of contact data on two color tactical displays. Information is displayed in both alpha numeric and graphical fashion representing ownship position, speed, known sonar and radar contacts, as well as intended and achieved track and coverage data. The system is designed around five 68020 processors presenting data on two tactical displays, two remote monitors, and a 36" x 48" plotter. Data for post-mission analysis is collected on a hard disk drive and magnetic tape.

Breach Lane Navigation Beacon (BLN) Ex-7 Mod 09

The Breach Lane Navigation Beacon has been developed to support over-the-horizon in-stride amphibious assaults. The system is a combination of Non-Developmental Item (NDI) hardware. All components used with the system are commercially available except the battery and battery container which are existing military items. The system is an ACAT IV M program and achieved a combined Milestone I/II/III in September 1995. The system provides precise guidance through lanes cleared in minefields for LCAC and amphibious assault craft in the final 1,000 yards through the surf zone and onto the beach. The system provides a 6 degree wide light beam, subtended into two equal sectors marked with red and green lights. Craft operators approaching the beach use the colored lights to provide them steering guidance to keep their craft on the centerline of the cleared lane. Procurement of 50 systems will be completed in FY 96.

Versatile Exercise Mine System (VEMS)

The Versatile Exercise Mine System (VEMS) is a microprocessor-based programmable exercise bottom mine capable of emulating a wide range of bottom influence mines — including foreign mines exploited for data and intelligence during Operation Desert Storm. The entire system is shipboard deployable aboard MCM-1 and MHC-51 class ships, allowing exercise scenarios to be reviewed and then programmed at sea to make efficient use of valuable training time. The VEMS reports real-time actuation (simulated-detonation) and target range data, and records ship and sweep influence data for later analysis and adjustment. The VEMS is a cost-

effective training aid for operational training of surface, airborne, and EOD MCM forces. Currently, 115 systems have been ordered for delivery. A follow-on production contract for additional systems has been awarded and a total of 150 systems are scheduled to be delivered by FY 99.

MCM-1-Class Degaussing System

The present degaussing system on the MCM-1 class ships is designated the MDG-1701. This system is designed to existing degaussing standards, and results in signatures comparable to those of the MSO ships that the MCM-1 class replaces. The Navy is in the process of developing an add-on system to the MDG-1701 called Closed Loop Degaussing (CLDG). This is a joint U.S. /France R&D program with an IOC of 2000. The prototype CLDG system is now being tested on MCM-10. The CLDG system will have the capability of lowering MCM-1 magnetic signatures on the order of 25 percent and allowing a much longer time between calibrations at degaussing ranges. Also, with CLDG, additional equipment could be made of magnetic material with no degradation of the magnetic signature.

Acoustic Silencing

Facing known acoustic threats, the acoustic deficiencies of the MCM-1 and MHC-51-class ships were only recognized in the February/March 1995 timeframe. These deficiencies were brought to light during the integrated acoustical trials conducted on MCM-13, MCM-14 and MHC-52. Initial fixes have been leveraged in large part from solutions developed under the ASW Silencing Program.

Airborne Systems

AN/AQS-14

The AN/AQS-14 is an active-controlled, helicopter-towed minehunting sonar, developed for retrofit into the RH-53D Sea Stallion helicopter, and is currently used in the MH-53E helicopters. It is a multi-beam, side-looking sonar with electronic beamforming, all-range focusing, and an adaptive processor. The system consists of three parts: a stabilized underwater vehicle, electro-mechanical tow cable, and airborne electronic console. The three-meter long underwater vehicle can be maintained at a fixed depth above the sea floor or below the surface, and the thin, coaxial cable is armored and nonmagnetic. Sonar information is presented on two continuous waterfall displays. The system's initial operational capability was in 1984 (RH-53D), and its first operational use came in August of that year during Operation Intense Look, the Red Sea/Gulf of Suez mine crisis. It was also used in the 1987-89 Earnest Will Operation as well as Operation Desert Storm, and provided support to USCG/EPA Operation Toxic Look in January 1992 where the system successfully located cyanide containers lost at sea.

SPU-1W (MAGNETIC ORANGE PIPE)

The SPU-1W "Magnetic Orange Pipe" (or "MOP") is a magnetized pipe filled with styrofoam for buoyancy. A modern version of the World War II-era iron-rail sweep (M Mk 1(m)), the MOP was conceived as a precursor sweep mechanism for helicopters during Operation End Sweep. The mines laid in Vietnamese waters were so sensitive that they would have destroyed Mk 105 sleds towed by helicopters. The MOP was also used to sweep waters too shallow for the hydrofoil sleds. A helicopter can tow as many as three MOPs in tandem to increase sweep effectiveness.

SPU-1W Characteristics

Length	**30 ft**
Diameter	**10 3/4 in**
Weight	**1,000 lb**

A Mk 2(G) Acoustic Sweep

The A Mk 2(G) acoustic sweeps (called rattle bars) for both surface vessels and helicopters consist of parallel pipes or bars, towed broadside-on, at speeds from 4 to 10 knots. This produces a Bernoulli effect between the bars causing them to bang together producing medium-to-high frequency acoustic energy. The A Mk 2(G) was used by helicopters during Operation End Sweep in North Vietnam and in Operation Desert Storm.

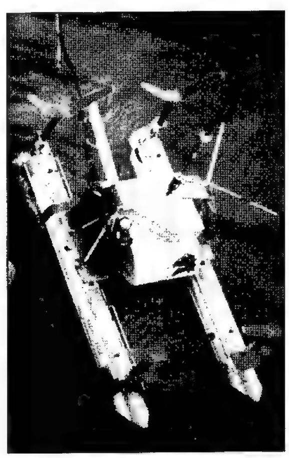
Mk 103 Mechanical Sweep

This helicopter-towed, moored-minesweeping system consists of a tow wire, sweep wires (with explosive cutters), floats, a depressor, otters and float pendants.

Mk 104 Acoustic Sweep

This airborne acoustic mine countermeasures system consists of a cavitating disk within a venturi tube, driven by two self-rotating, cavitating disks. The Mk 104 is towed behind a helicopter, or is attached to the Mk 105 sled to provide a combination magnetic/acoustic minesweeping system. Total system weight is 180 lbs. Towed body dimensions are width 26 in, height 35 in, and length 49 in.

Mk 105 Magnetic Sweep



The Mk 105 is a helicopter-towed minesweeping hydrofoil sled. It carries a gas turbine generator to power its magnetic sweep gear. Approved for U.S. Navy use in 1970, the Mk 105 was used during Operation End Sweep in 1973; in the Suez Canal sweeps in 1974-75; and in Operation Desert Storm. The sled is typically towed at 20-25 knots, about 450 feet behind the helicopter, with the gas turbine providing power to the twin magnetic tails (conventional open-electrode magnetic sweeps approximately 600 feet long). The sled becomes foil-borne at about 13 knots. Launch and recovery of the sled can be from a variety of surface ships (LHD, LHA, LPH, LPD, CV) as well as shore facilities and beaches. The system can be refueled from the helicopter during a mission. A combination influence sweep may be achieved by the addition of the Mk 104 or Mk 2(G) acoustic systems to the sweep array (see listing for the Mk 106 sweep, below). A program is underway to upgrade Mk 105 sustainability, reliability, and performance.

Mk 105 Characteristics		
Length	**27 ft 6 in**	
Width	**16 ft 6 in at top foil tip**	
	11 ft 6 1/4 in at float	
Weight	**Original Mk 105**	**Upgraded Mk 105**
sled (dry)	**5,907 lb**	**7,259 lb**
fuel	**748 lb**	**1,741 lb**
weight, fueled	**6,655 lb**	**9,000 lb**

Mk 106

The Mk 106 is a helicopter-towed acoustic/magnetic sweep, consisting of the Mk 105 sled and a Mk 104 attached to one of the magnetic tails. The Mk 106 was extensively used during the 1984 Intense Look sweeping operations in the Red Sea and Gulf of Suez.

A/N 37U MECHANICAL SWEEP

The A/N 37U Mechanical Sweep is a variable depth, helicopter-towed mechanical sweeping system, capable of sweeping moored mines in both deep and shallow water. It expands the area of AMCM mechanical sweep operations by providing a mechanical sweep system with a variable depth capability to sweep moored mines. Low rate initial production of 11 systems is underway.

ALQ-141

The ALQ-141 is an airborne mine countermeasure system designed to detect and counter specific mine types.

Explosive Ordnance Disposal MCM Systems

EOD MCM detachments and EOD Mobile Detachments provide mine identification, neutralization, reacquisition, and disposal capabilities for airborne and surface minehunting systems. Additionally, EOD MCM detachments conduct tactical field exploitation on enemy mines to aid the MCM commander in tailoring MCM tactics to the actual mine threat. To perform these tasks, EOD detachments must be equipped with systems to safely prosecute mines. EOD systems to accomplish this are categorized into three functional categories: (1) Diver Systems; (2) Detection/Location Systems; and (3) Mine Neutralization/Tactical Exploitation systems.

In-Service Diver Systems

The EOD MCM detachment is outfitted with the Mk 16 Underwater Breathing Apparatus (UBA). Operational testing has confirmed that the magnetic and acoustic signatures of this diving rig are well below the thresholds of even the most sensitive of influence mines. A rebreather, the Mk 16 has a dive duration of up to six hours at depths up to 200 feet. The overhaul of these systems includes product improvements which will increase diver safety, reduce decompression profile time, and extend the certified depth limit.

Other diver support systems in service include wet suit and dry suit systems, specialized EOD small craft tested for influence signatures for operations in unknown minefields, and various ancillary support systems such as fly-away diving support facilities, gas transfer systems, compressors, diver buoyancy compensators, etc.

In-Service Mine Detection and Location Systems

Various tools are required to aid an EOD detachment in safely reacquiring mines located by other systems. Perhaps most significant among these are the Portable Lightweight Geodetic Receiver-Global Positioning System(PLGR-GPS) and the AN/PQS-2 Diver Hand-held Sonar. The PLGR-GPS has literally revolutionized EOD tactics for prosecuting mines located and reported by minehunting platforms. Using the PLGR-GPS to get in close proximity to reported mines and then using the hand-held sonar to pinpoint and reacquire the exact location of the mines from the GPS diver insertion point has enabled reacquisition/disposal operations independent of minehunting/search/classification operations. This enhances safety and greatly improves efficiency of the mine hunting/neutralization process.

Additional in-service systems for detection and location include ordnance locators designed to detect buried mines as deep as seven to ten feet below the sea bed.

These systems are not designed for area searches, but rather for locating buried mines in a suspected location.

Mine Neutralization and Tactical Exploitation Systems

EOD Detachments are equipped with a CD-ROM field publication set of over 2,800 publications that contains approved procedures developed for prosecuting the full spectrum of unexploded ordnance (UXO). Additionally, the detachments use an assortment of specialized tools to render safe, remotely disassemble, and examine UXO (including mines). These systems enable EOD detachments to determine the condition, component arrangement, and the proper approach to safely neutralize, and if necessary, disassemble UXO for tactical intelligence information.

Marine Mammal Systems (MMS)

Marine Mammal Systems incorporate specially trained Atlantic and Pacific bottlenose dolphins and sea lions for mine detection and neutralization, swimmer defense, and recovery of exercise mines and torpedoes. The Navy's marine mammal program began in 1960 with several dolphins used in hydrodynamic studies addressing underwater missile design. The Navy later studied the animals' special deep-diving and location capabilities and determined that the dolphins and sea lions could be worked untethered in the open ocean. In 1985, the Navy restructured the program to focus exclusively on EOD mission areas and to ensure their "expeditionary" capability to deploy to forward areas. In some situations, the mammals are much more effective than people or existing hardware.

Each "system" comprises four-to-eight dolphins or sea lions, which may be quickly deployed by strategic airlift to any part of the world and can also be worked from ships in forward areas. Fleet operational marine mammal systems comprising about 40 animals are in EODMU Three at San Diego (bottlenose dolphins and sea lions) and EODMU Six at Charleston (sea lions), in four MMS programs:

- Mk 4 Mod-0 – Pacific bottlenose dolphins detect mines and attach neutralization charges on the mooring cables of buoyant "close-tethered" mines moored near the bottom. The Navy is working to expand this system's capability to neutralize all buoyant mines, whether close-tethered or not.
- Mk 5 Mod-1 – Sea lions attach recovery pendants to exercise mines and torpedoes and other test objects equipped with acoustic pingers at depths in excess of 500 feet.

- Mk 6 Mod-1 – Dolphins provide defense for harbors, anchorages, and individual ships against swimmers and divers. This system was first used at Cam Ranh Bay in Vietnam during 1970-71 and was deployed to Bahrain in 1988 during Operation Earnest Will. The Mk 6 participates regularly in fleet exercises and real-world base security. The Mk 6 is easily deployable, as are all of the Navy's marine mammal systems, requiring three C-141 sorties or one C-5 sortie to transport support vans, small boats, and equipment.
- Mk 7 – Dolphins detect, locate, and mark or neutralize proud bottom mines – those that are on the surface of the seafloor – and buried mines, offering the only operational buried-mine detection and neutralization capability in the world.

During RIMPAC 94 the Navy operated two Mk 4 and four Mk 7 MMS dolphins from the USS *Juneau* (LPD-10). The objective was to evaluate the integration of diverse mine countermeasures assets and to assess the ability of the marine mammals to conduct MCM operations from a surface ship at sea. The two Mk 4 dolphins made the 11-day surface transit from San Diego to Pearl Harbor on board *Juneau*, while the four Mk 7 animals flew directly from San Diego to Hawaii on strategic airlift aircraft. Once acclimated to the RIMPAC exercise area's environmental conditions, both Mk 4 and Mk 7 systems worked with AMCM helicopters embarked on *Juneau*, finding mines and operating "within system specifications." Most recently, the Mk 6 and Mk 7 MMS detachments deployed to Korea to participate in Exercise Freedom Banner 95. Both systems were effective in their assigned missions. The Mk 7 system successfully operated with AMCM forces to reacquire all of the exercise mines in the field.

USMC Systems

Track Width Mine Plow (TWMP)

The TWMP lifts and pushes surface laid or mines buried up to six inches deep in front of its path. A float assembly for each plow exerts enough pressure to activate most single pulse mines. This effectively clears a section of the centerline by explosive detonation, but may disable the plow. A "dog bone" and chain assembly between the plows defeats tilt-rod fused mines. Mines lifted by the plow are left in the spoil on each side of the furrowed path and remain a hazard until removed or neutralized. The plow can be mounted to any M1A1 tank without special preparation or modification. The three-ton plow restricts the tank's maneuverability and speed and prevents the tank from climbing vertical steps or negotiating gaps. The plow restricts the tank to a speed of less than 10 km/hr (depending on soil conditions when plowing). The plow creates a 58-inch cleared path in front of each track.

M58 Mine Clearing Line Charge

The Mine Clearing Line Charge is a rocket-propelled, explosive line charge used primarily to reduce minefields containing single-pulse, pressure activated anti-tank mines and mechanically activated anti-personnel mines. This system is a single, trailer-mounted line charge that can be towed by several vehicles including the Assault Amphibian Vehicle (AAV), Light Armored Vehicle (LAV), and five-ton truck. The line charge consists of 1,750 pounds of C-4 explosive that clears a lane approximately 14 x 100 meters.

MK 154 Mine Clearance System

The Mk 154 system — commonly referred to as a triple-shot line charge — is the primary explosive breaching system of the Marine Corps. The system consists of three rocket-deployed explosive line charges (M59) mounted inside an AAV. Each line charge clears a lane approximately 14 x 100 meters and is effective against single impulse pressure mines. Each Marine Corps Assault Amphibian Battalion is organized with a Mine Countermeasures Platoon consisting of 12 AAVs, six with the Mk 154 Mine Clearance System, and six chase vehicles for armored transportation of combat engineers during breaching operations.

Appendix C.

DEVELOPMENTAL MINE COUNTERMEASURES PROGRAMS

Surveillance Systems

Coastal Battlefield Reconnaissance and Analysis (COBRA)

COBRA is a UAV-based multi-spectral optical sensor system for detecting minefields and obstacles on the beach and in the craft landing zone. Sensor data is relayed via data link to a ground station for processing and dissemination. COBRA will provide expeditionary forces with near-real-time information on beach conditions. The sensor package is currently being tested from an airborne platform. Developmental and Operational Testing is expected to lead to a Milestone I decision in FY 96.

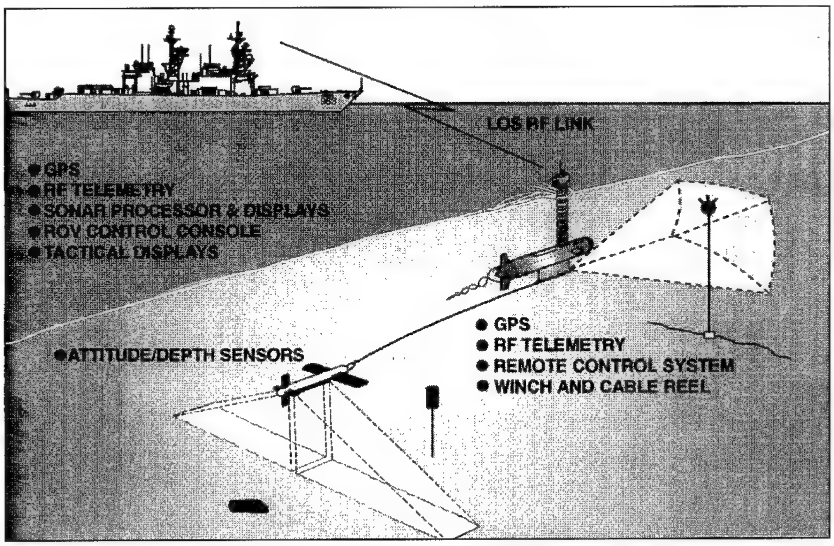
Radiant Clear

This project is a joint Navy/Marine Corps Tactical Exploitation of National Capabilities (TENCAP) effort conducted in conjunction with the Office of Naval Research, that focuses national systems support to military operations in the littoral environment. Based on advances in the processing of data collected by national systems, RADIANT CLEAR attempts to focus these advances to graphically depict the littoral environment and coastal defenses. Additionally, new sensors and technologies are being demonstrated to assess their contribution in providing intelligence inputs to a common tactical picture of the littoral battlespace.

Organic MCM Systems

Remote Minehunting System (RMS)

The Remote Minehunting System (RMS) is being developed to meet the Fleet's critical need for organic mine countermeasures for surface ships. RMS will be an organic, off-board mine reconnaissance system. As part of the advanced forces, surface ships will employ RMS to meet the demand for over-the-horizon mine reconnaissance of anticipated operating areas in support of the ship's individual mission and to prepare for the arrival of other naval forces. The RMS sensor suite will be used against bottom and moored mines for mine reconnaissance in deep



water to a portion of the VSW region. The RMS program acquisition strategy calls for a streamlined approach, delivering contingency capabilities to the Fleet near-term, enroute to the final, fully-supported RMS system. Completed in August 1994, the Remote Minehunting Operational Prototype (RMOP) represents the first contingency system capability. As a non-developmental initiative within the RMS program, RMOP combines and integrates the AN/AQS-14 minehunting sonar (on a variable depth winch) and the SEABAT forward looking sonar with the DOLPHIN semi-submersible. Additional follow-on developmental contingencies are being advanced to meet mid-term requirements, including improved vehicle performance and integration in *Spruance* (DD-963)-class destroyers.

Near-Term Mine Reconnaissance System (NMRS)

Mine reconnaissance is the Navy's highest mine warfare objective as well as the top Unmanned Undersea Vehicle (UUV) priority. Knowledge of the full dimension of the mine threat without exposing the reconnaissance platforms and the intentions of the tactical commander is vital to littoral warfare. To this end, both near-term and long-term programs have been established to deliver UUV mine reconnaissance capabilities to the Fleet. The initial capability has been designated the Near-term Mine Reconnaissance System (NMRS) and will provide the Fleet a UUV mine reconnaissance capability in FY 98. The single NMRS will be launched and recovered from a *Los Angeles* (SSN-688)-class submarine. NMRS will be capable of limited mine detection, classification, and localization with an inherent low risk to the host platform. NMRS capitalizes on existing technologies and capabilities in

order to reduce cost and be available in the near-term. The NMRS will be in operation until the Long-term Mine Reconnaissance System (LMRS) reaches its IOC.

Long-Term Mine Reconnaissance System (LMRS)

The Long-term Mine Reconnaissance System (LMRS) will replace the Near-term Mine Reconnaissance System (NMRS), providing the Navy and Marine Corps a significantly increased mine reconnaissance capability. The LMRS will operate from, and interface with, SSN-688, SSN-688(I) and NSSNs. Like NMRS, LMRS will detect, classify and localize mine-like objects in anticipated operating areas. However, LMRS will provide improvements in areas, where, due to the near-term focus, NMRS was inherently limited (e.g. number of systems, endurance, and search rate). The Navy is currently completing Concept Exploration and Definition studies and analyses that will define the requirements for the LMRS. Development contract(s) will be awarded by the end of FY 96. The LMRS is planned for operation well into the next century.

Rapid Airborne Mine Clearance System (RAMICS)

RAMICS is a research and development program designed to develop an effective anti-mine munition. The munition, designed for standard military weapons, will effectively destroy moored mines and some bottom mines in the water.

Advanced Degaussing Aid

This program has goals of reducing the magnetic signature of existing steel-hulled ships to one-half the present limit, of future steel-hulled ships to one-quarter the present limit, and of minesweepers to one-quarter the present limit. To do this the following technologies are being tested: corrosion current minimization, high field deperming, closed-loop degaussing for steelhulled ships, standard degaussing power amplifier, eddy current magnetic field reduction, stray magnetic field reduction, and degaussing system calibration algorithms. These technologies, after evaluation and completion of development, will be used on LPD-17 class, SC 21 ships, the CVX, and DDG-51 Flight IIA ships, as well as selected backfit on MCM-1-class, MHC-51-class and older classes of steel-hulled ships.

SSN Hull-Mounted Mine Detection Sonars

High Frequency Sonar Upgrades

The AN/BQS-15 is being upgraded with Engineering Change 17 (EC-17) which combines improved mine detection/avoidance with ice keel avoidance capability. New electronically steered receive/transmit arrays and advanced signal processing replaces the forward-looking portion of the AN/BQS-15 on *Los Angeles* (SSN-688)-

class submarines. EC-17 is derived from the Deep Submergence/Obstacle Avoidance Sonar (DS/OAS) family of sonars which includes the Experimental Under Ice Sonar (EXUS) and the Unmanned Undersea Vehicle (UUV) Mine Search Sonar. With greatly improved reliability, EC-17 also provides computer-aided detection (CAD), high resolution (color-refreshed) displays, target height above bottom measurement and provides an embedded on-board training capability. EC-17 has completed the first of its two scheduled sea tests with positive results. Two subsequent upgrades are planned. Additional hydrophones provided in EC-17 will be used for a Remote Ahead Profiling (RAP) capability and (EC-18), which provides a 3-D display of the bottom terrain or under-ice canopy to aid in precision navigation, under ice or in littoral waters. EC-19 will follow, providing a mission mapping capability along with track history and minefield planning.

Advanced Mine Detection System (AMDS)

The Advanced Mine Detection System (AMDS) program is an advanced development program that addresses the high frequency (HF) system shortfalls of current sonar systems for mine-like detection and avoidance and supports the requirements for the NSSN. Specifically, the AMDS is designed to improve shallow water mine warfare, provide reliable bottom mine detection and improve overall operation in harsh environments. AMDS was recently sea tested with good results. With a new HF receive array and improved processing, AMDS will also provide the ability to look ahead of the platform to provide bottom navigation and avoidance.

Airborne Laser Mine Detection System (ALMDS)

The ALMDS is a non-acoustic, laser-based mine countermeasures system that detects and localizes floating and shallow-water moored mines from tactical helicopter platforms. The system provides rapid reconnaissance of surface and near surface waters in the area of battle force operations and an organic mine-avoidance capability against drifting/floating and shallow-water moored mines during both day and night operations. Operational assessment of two advanced development models was completed in FY 95. Current plans to provide a contingency capability of this system to the fleet are in progress. Contingency systems will be integrated into SH-2G aircraft and will be available for use by FY 97.

Dedicated MCM Systems

Shallow-Water Assault Breaching System (SABRE)

SABRE is a discontinuous line charge system delivered by the Mk 22 Mod 4 rocket and deployed from an MCAC with a 200 foot standoff range. SABRE is designed to accomplish wide area neutralization of anti-invasion mines in both very shallow water and surf zones of the Amphibious Objective Area (AOA) thereby minimizing the loss of personnel and surface landing craft. This is a vital precursor operation to putting forces ashore using surface landing craft. Explosive effectiveness tests have shown line charges to be very capable of reducing light and medium obstacles on land and defeating mines located in water depths up to 10 feet.

Advanced Lightweight Influence Sweep System (ALISS)

The Advanced Lightweight Influence Sweep System (ALISS) is a modular lightweight magnetic and acoustic influence minesweeping system that will be employed by platforms which lack an inherent influence sweep capability (i.e. MHC-51, MCAC, SH-60 Helo). Its design will make it transferable among a variety of platforms. It will bring maximum efficiency to MCM operations by increasing the number of available platforms in the MCM operating area capable of conducting influence sweeping operations, resulting in high swept clearance rates and reduction of overall operation duration.

Very Shallow Water MCM Unit

An initiative is underway to develop a diver and marine mammal capability for conducting reconnaissance of the very shallow water (VSW) (10'to 40') zone to determine the presence or absence of mines and obstacles. This initiative will provide a near-term capability for conducting samples of potential landing sites in support of amphibious operations, a capability which has long been lacking.

Considerable progress has been made in sensor development and remote/autonomous systems, however several studies have indicated that the technology is not yet at hand to field systems with the required capabilities in the complex environment characteristic of the VSW zone. The VSW MCM Unit in the near-term will consist of divers and marine mammal systems, with the goal of getting divers out of the loop in the mid- and far-term, as technology initiatives offer unmanned alternatives.

The near-term VSW MCM Unit initiative capitalizes on the capabilities of EOD, Navy Special Warfare, and USMC Recon personnel. Procurement of a hydrodynamic, low influence underwater breathing apparatus, diver propulsion systems,

underwater precise navigation systems, and diver held detection systems will maximize the area search capability for these small units. Studies have confirmed that technology for enhancing diver capabilities is available, and most of the equipment required is either commercially available, or has been demonstrated and can be obtained through non-developmental initiatives.

The operational concept for the VSW MCM Unit is still in development. However efforts are aimed at developing a "toolbox of equipment and tactics" that will enable divers and mammals to optimize reconnaissance capabilities in the VSW zone without compromising potential landing sites.

Initially, the VSW MCM capability, like other EOD MCM forces, will reside in a dedicated, deployable unit under the administrative control of an EOD Group, and under operational control of the Commander, Mine Warfare Command. If naval operations require an amphibious assault option, the contingency force would be deployed to the theater of operations and embarked as part of the Amphibious Task Force.

As the tactics and equipment are developed and fielded, the capability would, then, in part, be exported to EOD and NSW forces organic to deploying ARGs. Finally, as the capabilities and technologies mature, divers in the VSW MCM Unit would gradually be phased out, and autonomous hardware systems phased in. The VSW Unit would continue to provide a flyaway capability, maintaining and operating autonomous systems.

Distributed Explosive Technology

Distributed Explosive Technology (DET) is a 180 x 180 foot distributed explosive net system delivered by two Mk 22 Rocket Motors launched from an MCAC with a 200-foot standoff range. The system is designed to provide a wide swath of clearance in the surf zone of the Amphibious Objective Area (AOA). The system will integrate components of the SABRE system where feasible and is designed for operation with SABRE in graduated clearing of an approach lane from the sea for amphibious landing craft. Land-based rocket deployment tests have demonstrated array and harness structural integrity and survivability. An inert, command-fired fuze, tested during array deployment tests, successfully deployed the array and achieved mechanical alignment of the components. The program has also successfully demonstrated a vertically distributed explosive array packaging scheme that will improve packing efficiency, reliability and ensure tangle-free deployment of both the harness and array.

Explosive Neutralization

The Explosive Neutralization program will incorporate new high energy explosive technologies, and existing delivery systems deployable from MCACs, and advanced delivery systems deployable from unmanned fixed wing aircraft, to provide the capability for in-stride clearance of mines in the surf, craft-landing, and beach zones of the Amphibious Objective Area. The system will eliminate the need for time consuming manned clearance operations in hostile environments. The goal of the program is to maximize the effectiveness of wide area clearance against a defended beach, eliminating the need for lengthy manned clearance operations, thereby minimizing the loss of personnel and surface landing craft. The program is a funded Advanced Technology Demonstration (ATD) program with the ongoing objective of initiating an acquisition program. A Cost and Operational Effectiveness Analysis for the program is currently scheduled for FY 98. The program has already designed, fabricated and statically test-fired new rocket motors for the extended standoff of line charges and completed a detailed feasibility study of alternative Beach Zone munitions deployment concepts. Motion tests were conducted from both LACV-30 and LCAC air cushion vehicles to assess maneuverability and hover capability in a variety of sea states, and the LCAC was selected as the deployment platform of choice.

Forward Area Combined Degaussing and Acoustic Range (FACDAR)

The mission of the FACDAR is to assist in carrying out the mine countermeasures policy of the United States by determining whether deployed ships meet magnetic signature requirements, and to measure and assess acoustic signatures. The FACDAR will be a transportable range providing the capability to measure and analyze the magnetic and acoustical signatures of deployed ships, allowing for precise degaussing adjustments for the geographic area and collection and processing of acoustic data. The FACDAR will be housed in transportable containers, and is planned as an essentially commercial-off-the-shelf non-developmental item (COTS/NDI) procurement.

Obstacle Breaching System

The Obstacle Breaching System is a broad-based program to explore both traditional and non-traditional concepts and techniques to clear physical obstacles located in the surf and craft landing zones. The program includes the examination of the breaching capability of existing DoD munitions including Mk 83 bombs. The program is testing concepts, techniques and equipment to determine feasible/

desired systems with the goal of deploying standardized munitions and breaching techniques in support of amphibious assaults. Operational objectives call for clearance of obstacles on land and in the surf zone to at least six feet below water, with 90 percent clearance achieved in less than two hours of operation. A Cost and Operational Effectiveness Analysis (COEA) has been conducted of all feasible alternative systems and the conclusion is that no known developmental material solutions can meet the present operational criteria. Operational criteria are currently under review.

Magnetic Cable Improvements

The Magnetic Cable Improvement Program is intended to increase the average life expectancy of the electrodes used on the Mk 105 magnetic influence sled. The life expectancy of current electrodes has been a limitation in past AMCM operations. The new electrodes are designed for increased life expectancy and will handle a higher power output while staying within the size parameters of existing support equipment.

AN/AQS-20

An airborne towed minehunting sonar consisting of a Mission Control Display Subsystem, an AMCM Console Subsystem located in the helicopter, and a Towed Body Subsystem. The towed body includes side-looking, gap-filling, volume-searching, and forward-looking sonars. In conjunction with the Airborne Mine Neutralization System, the AQS-20 makes up an Airborne Minehunting and Neutralization system effective against bottom and moored mines in both deep and shallow waters. The AQS-20 will provide a ten-fold increase in area covered in comparison to the current AQS-14 system and can provide single pass detection of bottom and moored mines. The first production unit is scheduled for delivery in FY 01. The AQS-20 sensor package is also being considered for use in the design and production of the Remote Minehunting System (RMS).

Airborne Mine Neutralization System (AMNS)

The AMNS is an expendable, airborne delivered, remotely operated, mine neutralization device, capable of providing rapid destruction of bottom and moored mines, with little or no risk to helicopter and aircrew/EOD personnel. AMNS will be developed for use in naval helicopters and will be used to reacquire and neutralize previously identified mine-like contacts.

EOD Developmental Programs

Several systems are in development which will improve EOD safety and capabilities in diving, mine detection and reacquisition, neutralization, and recovery and tactical exploitation missions.

Mobile Support Facilities. These systems will provide field recompression treatment and UBA maintenance and repairs to improve EOD MCM detachment sustainability and enhance diver safety.

Mk 16 UBA Improvements. Improvements are being developed that will be incorporated during overhauls of currently certified systems to enhance diver capabilities and safety, and extend the service life of the system. Addition of a full-face mask and an underwater communications system will improve diver safety and enable real-time voice communications between divers, and between a diver and his surface support craft. Increasing the O_2 setpoint and development of new decompression tables is also ongoing to decrease the susceptibility of divers to bends, and decrease the in-water decompression time which limits divers most significantly at deeper depths.

Diver Evaluation Unit (DEU). Delivery of the DEU to EOD MCM detachments will provide a portable, influence sensor-actuated training device to develop diver discipline during mine neutralization, disposal, and recovery training evolutions and exercises. The system satisfies the requirement for diver and dive team training in minefield discipline. The device is deployable and retrievable by the EOD team using small inflatable craft and divers. It provides immediate feedback to divers when a magnetic, acoustic, or seismic sensor threshold is exceeded and will record all diver-induced actions.

Acoustic Firing System (AFS). The AFS is an explosive charge initiator to enable positive control of detonations through the use of a coded acoustic pulse. The system will improve reliability of diver-placed explosive charges and improve safety. The system also offers an alternative for preparing obstacles and mines for explosive neutralization in the very shallow water zone.

Deep Water Lift System (DWLS). The DWLS is a portable floating winch that is deployable from small inflatable craft for raising underwater ordnance and objects from the bottom for breaching and field exploitation. The system enables lifts of up to 2,250 lbs from 300 feet of water.

Advanced Radiographic System (ARS). The ARS is a computer-enhanced field radiographic system that allows the operator to remotely view internal components of mines and mine components once recovered from the water column.

USMC Systems

Joint Amphibious Mine Countermeasures (JAMC)

JAMC is a multi-functional landmine countermeasures system being developed for minefield and obstacle breaching and clearance of the craft landing zone during assault operations as well as rapid follow-on clearance. The system employs remote-controlled tractors with mechanical, explosive and electromagnetic MCM subsystems in addition to visual and electronic marking devices. The multiple MCM and marking subsystems allow very high clearance levels and positive marking for all ground elements of the assault force. JAMC development involves several new MCM subsystems and integration of existing MCM equipment. JAMC is beginning ATD within the Concept Exploration and Definition phase of development. Milestone I is planned for 3rd Quarter FY 97.

Magnetic Countermine System (MACS)

MACS is a landmine countermeasures system designed to defeat magnetic influence mines through signature duplication. This system consists of a vehicle power interface, signal controller, operator's panel, wire coil, and coil armor. It is designed to interface with the main battle tank, AAV, and LAV as a temporary kit. In an assault breaching mode, the MACS will be deployed in conjunction with other countermine assets, such as plows, rollers, and explosives. The MACS is a unilateral Marine Corps program and is currently in the Engineering and Manufacturing Development Phase. This program will transition to the Production-Deployment Phase in 1st Quarter FY 98.

Standoff M/F Breacher (SMB)

The SMB combines the U. S. Marine Corps' Distributed Explosive Mine Neutralization System (DEMNS) and the Army's IDX technologies into a unified effort. The system is an 8 meter by 145 meter rocket launched net array with small shaped charges evenly dispersed throughout. It will be mounted on or towed by a host vehicle. The system attacks and destroys all known surface and subsurface mine and submunitions in the breach lane. The system is currently in post Milestone I and has entered a 27-month Demonstration and Validation phase. Initial production of the system is scheduled in FY 03 with a full operational capability in FY 07. The Army is the lead service.

Combat Breacher Vehicle (CBV)

The CBV will provide an enhanced combat breaching capability on a single chassis with multiple breach mechanisms. Using the existing M1 tank chassis the CBV will have tactical mobility equal to the maneuver force. The vehicle will be equipped with a full-width mine plow (14 ft) with automatic depth control. It will also be equipped with a telescopic excavating arm capable of extending 30 feet with a lift capacity of 4,000 pounds or extending to 14 feet with a lift capacity of 10,000 pounds. The CBV will possess rapid smoke obscurant capability.

Anti-Personnel Obstacle Breaching System (APOBS)

APOBS is a two-man portable, one-time use ordnance item employed to breach lanes through anti-personnel minefields and wire obstacles. It is designed to replace the M1A2 Bangalore Torpedo Demolition Kit. The system is a rocket-deployed line charge that breaches a 1 meter by 45 meter path, can be employed in 30-60 seconds, and weighs 120 pounds. APOBS is a joint Marine Corps/Army program with the Marine Corps as the lead service. The program is scheduled to begin Production and Deployment phase during 2nd Quarter, FY 96.

Appendix D.

MINE COUNTERMEASURES TECHNOLOGY INITIATIVES

Mine warfare research and technology development is conducted at all levels of scientific study. These initiatives include basic research (6.1 program elements), exploratory efforts (6.2), technologies and systems demonstrations (6.3A) including Advanced Technology Demonstrations (ATDs), foreign systems acquisition, initiatives from U.S. industry, and non-developmental or commercial off-the-shelf items (NDI/COTS).

The MCM technology program at the Office of Naval Research (ONR) is based on an integrated MCM Science and Technology plan developed within the S&T community. The most recent program review, based on current Navy/Marine Corps needs and programs, resulted in the continuation and expansion of the program. A new program, the MCM Accelerated Capabilities Initiative (ACI), was established at ONR. In addition, ONR was tasked by the Office of the Secretary of Defense to develop a Countermine Advanced Concept Technology Demonstration (ACTD). These efforts formulated the FY 95 MCM technology program.

The thrust of the current technology plan is the development of technology that enhances MCM clandestine reconnaissance and in-stride clearance in amphibious operations. Accordingly, the technology programs and their goals are:

- An amphibious objective area (AOA) MCM reconnaissance/hunter program to develop the technologies required to detect, classify, and identify mines in shallow water and very shallow water and develop an in-stride mine neutralization capability. Goals include development of high resolution acoustic and non-acoustic sensors compatible with this harsh environment, integration of these sensors for simultaneous operation in a small underwater vehicle, sensor and signal processing software to facilitate detection, classification, and identification, and a technology assessment of in-stride mine neutralization concepts to eliminate mines prior to an assault.
- A mine reconnaissance technology program to develop underwater MCM sensors and signal processing for a reconnaissance capability to detect and classify moored and proud bottom mines. The goal of the program is to

develop and demonstrate long range minehunting sensors and associated computer-aided detection and classification processes that are compatible with remotely operated vehicles or unmanned underwater vehicle deployment.

- A surf zone technology program to develop the capability to clear obstacles and anti-invasion mines from the shore to 10-foot water depths.
- An airborne light detection and ranging (LIDAR) high speed reconnaissance technology program to address the pacing technology issue of high data rates and false alarm rates in the surf zone and craft landing zone. Goals include the development of high frame rate cameras to accommodate high data rates and the development of algorithms to detect small targets at high speed in complex clutter.
- A mine warfare simulation program to develop and use computerized mathematical tools to analyze and evaluate mine warfare technologies. A capability to do comprehensive assessments of investment alternatives and a framework for detailed MCM design, analysis, and planning will be developed.

Research in support of increased capabilities in MCM surveillance, reconnaissance, clearance, mining, and C^4I is ongoing. Efforts in response to the Navy/Marine Corps priority issue of mine surveillance and reconnaissance are investigating synthetic aperture radars, advanced deployable systems and signal processing, environmental physics, data fusion/compression, high-resolution imaging sonars, sensor netting and high repetition rate lasers. Ongoing efforts in mine clearance and neutralization are focusing on acoustic, electro-optic, and magnetic sensors; influence sweeping signal sources and energetics. Research centered on our mining capabilities is looking at target recognition algorithms, electric field sensors, acoustic modems, and artificial intelligence with the goal to develop future mines that can be remotely commanded, and incorporate a form of IFF. Underpinning all of these efforts is ongoing research in wide band connectivity, human-computer interfaces, and learning algorithms that will support development of improved C^4I systems to incorporate full-up, end-to-end distributed, interactive simulation, improved tactical decision aids, and system tradeoff analyses.

Appendix E.

NAVAL MINES AND MINE DELIVERY PLATFORMS

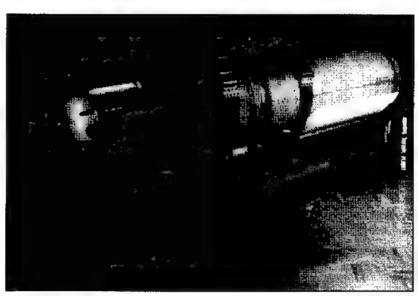
Naval Mines

Mk 56 ASW Mine

The Mk 56 is an aircraft-laid, 2,000 pound shallow/medium depth moored mine that was specifically designed for use against high-speed, deep-operating submarines. It has a nonmagnetic, stainless-steel case and is fitted with a magnetic firing mechanism using a total-field magnetometer as its detector. Total-field magnetometers are three-dimensional target sensors that respond to changes in the earth's magnetic field caused by the presence of a large quantity of metal such as a ship. The Mk 56 was released for production in 1960 and became operational in 1966.

When laid, the mine sinks to the bottom where case and anchor separation take place. Should the mine become embedded in bottom sediment before case/anchor separation and mooring takes place, a slow-burning propellant in the anchor is ignited which frees the mine from any mud it may be buried in. As the case rises, a hydrostat, which clamps to an 18-foot loose bight in the mooring cable, senses the preset mooring depth and falls free to release the loose bight, thus permitting the tension on the cable to relax and cause a pawling mechanism in the anchor to lock and stop further cable payout. Should the mooring mechanism allow the mine to rise to a depth too shallow, the case will scuttle. This feature reduces the possibility of compromise and eliminates a navigational hazard. Scuttling will also occur on sterilization or if the mooring cable breaks.

Mk 60 Captor



The Mk 60 CAPTOR (enCAPsulated TORpedo) is the U.S. Navy's principal anti-submarine mine. It can be laid by aircraft, submarines, or surface ships. CAPTOR acoustically detects moving submarines while ignoring surface ships and upon detection launches a Mk 46 Mod 4 or Mod 6 light-

weight, acoustic-homing torpedo. IOC was reached in September 1979 and the weapon was approved for service use in February 1980.

Quickstrike Series

The U.S. Navy's Quickstrike (QS) Mk 62, and Mk 63 series of aircraft-laid bottom mines are conversions of Mk 80 series bombs. Closely related to the earlier Destructor series of mines, the Quickstrikes use a similar variable influence-type target detection system. The Mk 65 Quickstrike differs substantially and will be discussed later. The conversion includes the installation of a modular arming kit containing an arming device, explosive booster, and target detection device (TDD). The great advantage of the Quickstrike program is that the United States need not stockpile large numbers of mines. Instead, it can stockpile large numbers of specialized kits. Quickstrike's design emphasizes ease of maintenance, preparation, and use. All were approved for service use in the early 1980s.

Mk 62 Quickstrike

The Mk 62 Quickstrike, an aircraft-laid bottom mine for use against submarines and surface targets, is a modified Mk 82 500-lb bomb. Mod 0 uses the Mk 57 TDD (magnetic/seismic); Mod 3 will use the Mk 71 TDD (magnetic/seismic/pressure).

Mk 63 Quickstrike

The Mk 63 Quickstrike, an aircraft-laid bottom mine for use against submarines and surface targets, is a modified Mk 83 1,000-lb bomb. It uses the same TDDs as the Mk 62 Quickstrike.

Mk 65 Quickstrike

The Mk 65 Quickstrike is a thin-wall, aircraft-laid, 2,000 lb bottom mine. It was designed as a mine and is the largest of the Quickstrike series, being approved for service use in 1983. Mod 0 uses the Mk 57 TDD; Mod 1 uses the Mk 58 TDD; Mod 3 will use the Mk 71 TDD (magnetic/seismic/pressure).

Mk 67 SLMM

The Submarine-Launched Mobile Mine (SLMM) is a self-propelled torpedo-like mine that permits clandestine mining by submarines in waters that are inaccessible to other means of delivery. It is also a shallow-water, bottom mine for use against submarines and surface ships. The SLMM consists of a modified Mk 37 Mod 2 torpedo, designated the Main Assembly Mk 4, with the wire guidance equipment removed and warhead replaced by the Explosive Section Mk 13. This section con-

tains the exploder and arming device, firing mechanism or target detection device and associated battery as well as the main explosive charge.

The Mk 67 is launched from the submarine as a torpedo toward the intended mining area. At the appropriate time/distance, the torpedo motor shuts down, and the weapon sinks to the bottom and arms as a mine. Mod 0 uses the Mk 57 TDD (magnetic/seismic); Mod 1 uses the Mk 58 TDD (magnetic/seismic/pressure); and the Mod 2 uses the Mk 42 Firing Mechanism (magnetic/seismic). IOC was reached in 1987.

Mine Delivery Platforms

We continue to focus on rebuilding our mine delivery capability. The accelerated retirement of two of the Navy's mine delivery platforms — the A-6 Intruder and nuclear attack submarines (SSNs) — requires innovative solutions to guarantee that we have the numbers of delivery systems required to execute operational plans.

Nearly every naval combatant aircraft that carries bombs can be rigged to carry mines. Table 1 shows the current U.S. Navy and Air Force aircraft and U.S. Navy SSNs that are certified for mine delivery missions, and provides a qualitative appraisal of their relative capability to deliver our current inventory of mines. *Sturgeon* (SSN-637)-class attack submarines continue to be phased out as they reach the end of their service lives. Several early units of the *Los Angeles* (SSN-688)-class submarines have already been retired, with others to follow as the submarine force moves towards the Administration's goal of 45-55 ships. The *Seawolf* (SSN-21) class will be capable of delivering mines, but only three units will be acquired. The next generation New Attack Submarine, which will also be capable of mine delivery missions, will fill out the future submarine force.

The A-6 Intruder, the Navy's only high-volume mine-capable aircraft is scheduled for retirement by FY 98, leaving the F/A-18 Hornet, the F-14 Tomcat, and S-3B Viking as the only operational carrier-based aircraft that can deploy mines. The P-3C Orion maritime patrol aircraft also has an important mine delivery role.

The Air Force's mine-delivery capability continues to be affected by recent downsizing. The FY 96 Air Force inventory includes 66 B-52Hs, 95 B-1Bs, and 20 B-2s, with projections for the maximum number of primary mission aircraft available seen as 56 B-52Hs, 82 B-1Bs, and 16 B-2s. The Air Force's *Bomber Roadmap* — the principal planning document used by the Air Force to formally identify the missions, force structure, and acquisition strategy for its long-range bomber force

— called for all three aircraft to have an air-delivered minelaying capability.

Today, the B-52H Stratofortress bomber is the nation's sole airborne, high-volume minelaying platform. B-52Hs currently in the Air Force inventory will continue service into the next decade, but will be retired soon thereafter. The B-1B bomber has been tested in the minelaying role, and in light of its new emphasis on conventional strike missions, should be available for minelaying tasks. However, at the present time the B-1B has not been configured for this mission and near-term upgrades currently do not include this capability. Budget constraints may result in the transfer of 24 B-1B aircraft into a reserve status available for reconstitution to the active force when required. These aircraft will continue to be maintained and updated along with aircraft in the active inventory but will not be assigned regular crews. The restriction of the B-2 "Stealth" bomber program to no more than 20 aircraft continues to make it unlikely these very few — and very expensive — aircraft will be available to support Navy mining missions.

The compelling case for development of an airborne high-volume minelaying system, especially a modular system for adaptation to existing military transport aircraft, continues to exist. Similarly, as U.S. Naval doctrine and strategy focuses on regional crises and conflict, the Navy must be innovative in adapting currently available platforms, such as surface combatants and surplus SSBNs, as high-volume mining platforms capable of supporting joint expeditionary warfare requirements.

U.S. Mine Delivery Platforms and Mine Types 1996

Mines	Navy and Air Force Aircraft								Attack Submarines			
	A-6	F-14	F/A-18	P-3	S-3	B-52	B-1B	B-2	637	688	SSN-21[7]	NSSN[7]
Destructor Mk 40 QUICKSTRIKE Mk 63 [1]	10	–	4	11	4	18	–	–	–	–	–	–
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CAPTOR Mine Mk 60 [3]	5	–	4	6	2	18	–	–	48	26	50	24
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SLMM Mk 67 [5]	–	–	–	–	–	–	–	–	48	26	50	–

Notes:

[1] Quickstrike mines Mk 62/63 are air-delivered bottom mines that use Low-Drag, General Purpose Bombs Mk 82/83 (500/1000 pounds) as the explosive payload. They are effective in shallow water and on land. Quickstrike is an improved version of the Destructor series of mines now being phased out of inventory.

[2] Moored mine Mk 56 is an air-delivered, 2000-pound, moored mine used in intermediate water depths against submarines and

[3] CAPTOR mines Mk 60 are capable of delivery by aircraft, submarines, or surface ships. The mine is a deep water anti-submarine mine that launches a Torpedo Mk 46 when it detects a valid target.

[4] Quickstrike mines Mk 65 are air-delivered, 2000-pound, thin-wall, bottom mines used in shallow water against submarines and surface ships.

[5] Submarine-Launched Mobile Mine (SLMM) Mk 67 is the only shallow water mine capable of covert delivery by submarine into an enemy port.

[6] The B-1B and B-2 are not yet fully certified to carry Quickstrike mines Mk 62.

[7] The SSN-21 and NSSN will be certified to deploy mines as they are introduced to the fleet.

A-6E Intruder

The Intruder is a two-seat, twin-turbofan, medium-attack aircraft that can deliver a large weapon load over long ranges. The aircraft's primary sensors are a multi-mode radar and a forward-looking infrared (FLIR) set mounted, along with a laser designator, in a chin-mounted ball turret. The latest version of the A-6 can carry a full range of guided and unguided ordnance, including gravity and laser-guided bombs (LGBs), Harpoon anti-ship missiles, High-Speed Anti-Radiation Missiles (HARM), and Standoff Land-Attack Missiles (SLAM). It can also deliver Mk 62/63/65 mines, the Mk 56 ASW mine, and the Mk 60 CAPTOR.

The A-6E Intruder is being phased out of the Navy's inventory, this process being completed by FY 98. Introduced into service in 1963, the A-6 has provided the Navy with an all-weather, 24-hour per day strike capability for more than three decades. Ultimately, the medium attack mission will be assumed by an aircraft resulting from the current Joint Advanced Strike Technology (JAST) program around the year 2010.

F-14 Tomcat

The F-14 Tomcat is a supersonic, two-seat, twin-engine, swing-wing, air-superiority multirole fighter/attack aircraft. The F-14A and F-14B incorporate mostly analog avionics. The F-14D features digital avionics and a dual chin pod designed to house the Infrared Search and Track System (IRST) along with the Television Camera Set (TCS) found in the F-14A/B single chin pod. In air-to-air fighter missions, the F-14 employs Phoenix, Sparrow, and Sidewinder missiles and an internal 20-mm cannon. In air-to-ground missions, the F-14 employs conventional air-to-ground ordnance. Air-to-ground weapons are carried on four fuselage stations using weapon rails equipped with BRU-32 bomb racks. Among the air-to-ground stores currently cleared for use from the F-14 are: Mk 80 series general purpose bombs; cluster munitions; Paveway II laser-guided bombs (GBU-10/16); the Tactical Air-Launch Decoy; various training stores; and Mk 62 Quickstrike mines (BSU-86 fin). Weapon release and control on the F-14D is accomplished with the AN/AYQ-15 Stores Management Set (SMS) and associated MIL-STD-1553B data bus controller and remote terminals. The F-14A/B uses the AN/AWG-15F Fire Control Set for weapon release and control.

F/A-18 Hornet

The F/A-18 is a twin-engine, twin-tail strike fighter operated by both Navy and Marine Corps squadrons. The Hornet supplements the A-6 (and eventually the F-

14) in the strike role, and the F-14 in the fleet air defense mission. At present, there are four Hornet models in service: the single-seat A and C versions and dual-seat B and D aircraft. They will be followed, and eventually replaced by, the F/A-18 E (single seat) and -18 F (dual-seat) Hornets. Deliveries of the F/A-18 C/D will continue through FY 98, while procurement of the new Hornet will begin in FY 97. The first F/A-18 E/F fleet squadron will reach operational status in FY 01.

The Hornet can carry out various attack missions while maintaining its fighter and self-defense capabilities. The aircraft is equipped with an advanced multi-mode radar, forward-looking infrared (FLIR) sensors, and laser designators. Hornets can carry a wide range of air-to-air weapons, including the AIM-120 AMRAAM, AIM-7 Sparrow, and AIM-9 Sidewinder missiles. For air-to-surface missions, F/A-18s can carry a mix of dumb and guided weapons. For the mining mission, the Hornet can deliver the Mk 60 CAPTOR, Mk 62/63/65 Quickstrike, and Mk 56 ASW mines. The aircraft also has an internal 20-mm cannon.

The F/A-18 E/F is an improved version of earlier Hornets. It will be a larger aircraft, allowing it to carry a greater internal fuel load. It will also incorporate new engines, new cockpit displays, two additional bomb stations and enhanced survivability features.

P-3C Orion

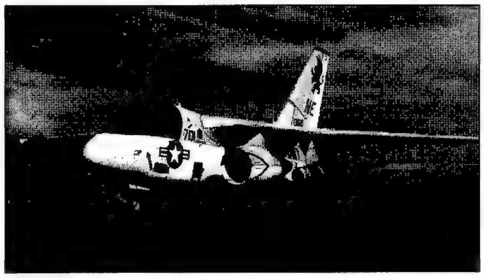
The P-3C is a long-range maritime surveillance and ASW aircraft. The Orion is adapted from the Electra commercial airliner, and variants of the aircraft serve in electronic intelligence and other utility roles. The aircraft has been updated numerous times since its introduction in the 1960s.

Powered by four turboprops, the Orion can remain on station far from its home base for significant periods of time. The aircraft carries a varied package of sensors, including inverse synthetic aperture radars, sonobuoys and associated acoustic processing equipment, FLIR, electronic surveillance gear, and a magnetic anomaly detector (MAD). The P-3C can carry ASW torpedoes, depth bombs, Harpoon anti-ship missiles, or mines either internally, or on internal hard points. The Orion can deliver Quickstrike series mines, the Mk 56 ASW mine, and the Mk 60 CAPTOR.

S-3B Viking

The S-3B Viking is a carrier-based, fixed-wing aircraft that provides the carrier battlegroup with anti-surface, anti-submarine, and surveillance capabilities. It can

also fill other combat and combat support roles such as tanking, electronic warfare, and strike support.



A wide variety of sensors and weapons make the Viking a versatile aircraft. It is equipped with an inverse synthetic aperture radar, which gives it a stand-off detection and identification capability. It is also equipped with FLIR, sonobuoys, electronic surveillance measures (ESM), and acoustic processing equipment and MAD. The S-3 can carry Harpoon, Mk-80 series bombs, rockets, Mk 46 ASW torpedoes and Mk 62/63/65 Quickstrike mines, the Mk 56 ASW mine, and the Mk 60 CAPTOR.

B-52H Stratofortress

The B-52 is a large, subsonic bomber with intercontinental range. It entered U.S. Air Force service in 1955, and has since been regularly updated to keep pace with evolving missions and threats. Only 66 B-52H models remain in service.

The B-52 can perform air interdiction, offensive counter-air, and maritime support operations, carrying up to 70,000 pounds of weapons in the pursuit of these missions. B-52s are equipped with a terrain-avoidance system, an electro-optical viewing system composed of FLIR, low-light television sensors, and night-vision-goggle-compatible cockpits.

B-52s can carry a range of ordnance, from "dumb bombs" to AGM-86 conventional air-launched cruise missiles, Harpoons, and AGM-142 attack missiles. They can carry every air-delivered mine in the U.S. inventory.

B-1B Lancer

The B-1B is a multi-role, long-range Air Force bomber capable of flying intercontinental missions without refueling and penetrating sophisticated enemy defenses. The B-1B represents a major upgrade in U.S. long-range capabilities over the B-52, the previous mainstay of the bomber fleet. Some of the B-1B's attributes include a low radar cross-section, greater speed and agility, a large payload capability of conventional and nuclear weapons, and an enhanced electronic countermeasures suite. Advanced avionics on the B-1B, which reached IOC in 1986, also give it an automatic terrain-following and precise weapon delivery capability.

The B-1B can carry up to 84 Mk 82 500 lb bombs internally. Initial certification tests have been completed for the Mk 62 Quickstrike mine. Once certified, the aircraft could become available for minelaying tasks.

B-2 Spirit

The B-2 is the newest bomber in the U.S. Air Force arsenal. Acquired and fielded as a 20-aircraft fleet, its unique stealth advantage, combined with global range and a large payload capability allow it to penetrate almost any hostile environment. Its survivability characteristics make it a prime candidate to attack highly defended targets using weapons like the Joint Direct Attack Munition (JDAM), guided tactical munitions dispensers, mines and standoff weapons. The first B-2 was accepted by the Air Combat Command in 1993, as part of the 509th Bomber Wing, Whiteman Air Force Base, Missouri. The B-2 can carry up to 80 Mk 82 500 lb bombs internally. Initial certification tests have been completed for the Mk 62 Quickstrike mine. Upon completion of certification, the B-2 could become available for minelaying tasks.

Los Angeles (SSN-688) *Class*

Los Angeles (SSN-688)-class nuclear-powered submarines are currently the mainstay of the U.S. attack submarine fleet. A total of 62 of these platforms have been acquired, the lead ship entering service in 1976. Older units in the class will be retired before the end of their useful service lives due to fiscal restraints.

The *Los Angeles* submarines have a submerged displacement of roughly 6,900 tons. Older boats can carry 25 torpedoes, Tomahawk Land Attack Missiles (TLAMs), Harpoons, or mines in their torpedo rooms. Newer versions (the final 23 submarines funded from FY 83 onward) are equipped with vertical launch systems in their bows that allow them to carry an additional 12 TLAMs. These vessels — referred to as Improved *Los Angeles*-class submarines — also feature a number of other improvements in sensors and quieting. All submarines of this class can deliver the Mk 60 CAPTOR or the Mk 67 Submarine Launched Mobile Mine (SLMM).

Seawolf (SSN-21) *Class*

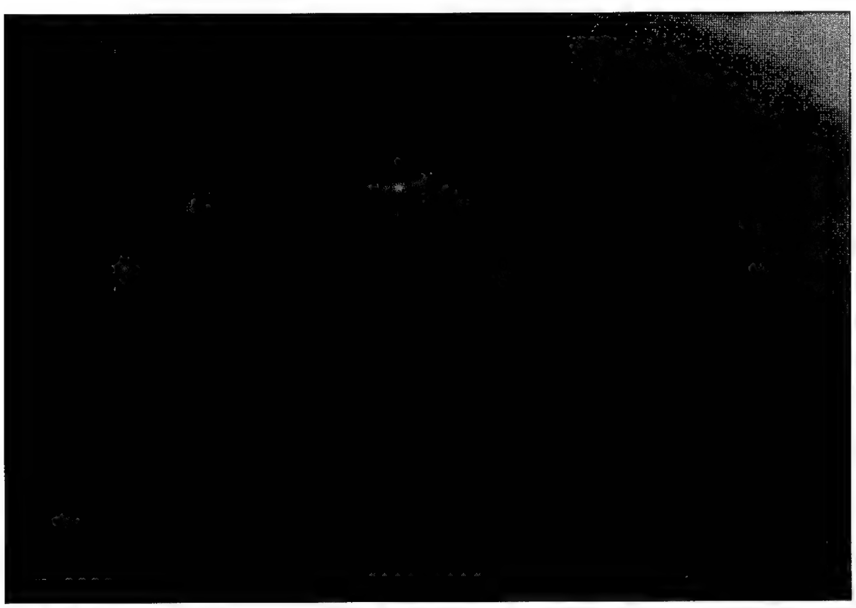
The nuclear-powered submarines of the *Seawolf* (SSN-21)-class will be capable of an entire spectrum of post-Cold War missions, including battlespace dominance, precision covert strike, and clandestine insertion of special forces. They will be capable of near-silent operations in all environments, from deep-water to the littorals. Displacing nearly 9,200 tons submerged, they feature improved quieting, sensors, weapons payload, and machinery. *Seawolf*-class submarines will be able to

carry up to 50 TLAMs, Harpoons, torpedoes, or mines, including the SLMM and CAPTOR. Their combat systems suite will be the most advanced in the world, exceeding those of any adversary's submarine. The lead ship of the class is scheduled for delivery in FY 96.

New Attack Submarine (NSSN)

The New Attack Submarine, now in its design stage, will be an advanced, follow-on submarine designed to augment the *Seawolf*-class and replace SSN-688 submarines as they retire early in the 21st century. The new submarine is being designed for multi-mission operations and enhanced operational flexibility. The first submarine of the class will reach IOC in FY 06.

The NSSN will feature many of the same advances in technology as *Seawolf*, but in a smaller hull. It will have *Seawolf*-level quieting, as well as sophisticated surveillance capabilities and the ability to support special warfare missions. The New Attack Submarine will be armed with 38 weapons. Twelve Tomahawk Land Attack Missiles and anti-ship cruise missiles will be carried in vertical launch tubes, while 26 other weapons — including mines — will be launched from four torpedo tubes. The NSSN design will also incorporate advanced electronics, sensors, and command-and-control systems.



Appendix F.

NAVAL MINE TECHNOLOGY PROGRAMS

Mine Improvements

An ongoing mine improvement program is a continuing development effort that attempts to measure, analyze, and model characteristics of priority targets and quantify the performance of U.S. mines against them. The program also modifies minefield planning models for priority targets, improved mines, and available mine delivery assets; improves mine components to respond more effectively to identified priority targets; and improves mine power supplies to extend capabilities and reduce environmental concerns.

Mine Development Programs

There are currently no mine development programs in place other than a small mine improvement effort designed to address emerging mining issues, such as power supplies and improved mine planning techniques. As mentioned, assessment of requirements is presently underway to determine steps required to assure strong out-year mining capability, but no new mine development program has, as yet, been initiated.

Mine Technology Programs

As with mine countermeasures, an aggressive mine technology program is being supported to augment mine development efforts. Specific programs include the following efforts, which are all directed toward specific mine requirements:

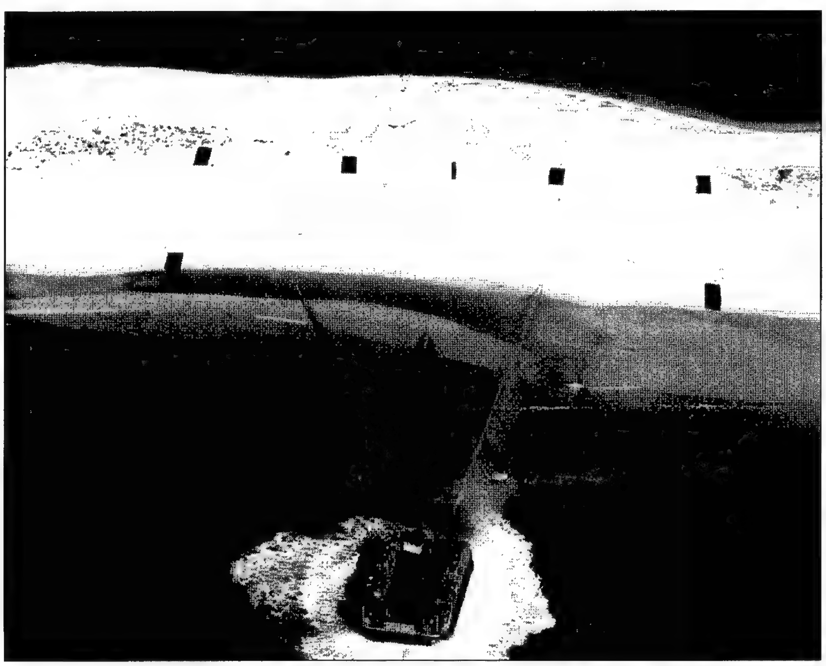
Exploratory Development (6.2)

A variety of 6.2 programs are being supported in consonance with existing mine requirements. Specific examples include:

- Bottom Mine Technology provides advanced influence sensor and target signal processing techniques for effective bottom mines against low-speed targets in adverse environments.
- Mine Communications and Control exploits communications between mines, surveillance systems, and ships/aircraft for enhanced minefield effectiveness

through improved detection, localization, and tracking of targets via multi-sensor data fusion.

- Littoral Sea Mine Technology develops long-range, low-power, integrated multi-sensor/processing technologies to detect, classify, track, and give mine fire control solutions for all targets in medium-depth waters.
- Modeling and Simulation uses automation to assess effectiveness of mine technologies and concepts.
- Armed Autonomous Surveillance Network develops autonomous, deployable surveillance capability that can be armed with mobile mines used in cooperative engagement in littoral waters.



Appendix G.

MINE WARFARE C^4I

Several C^4I initiatives are underway to improve mine warfare C^4I capabilities. Most significant is the installation of Joint Maritime Command Information System (JMCIS) compatible hardware on MCM ships. Four ships will have installations complete by FY 96 with the remainder completed by FY 98. This program will furnish real-time digital information exchange, data links, automated support for information and a satcom capability.

The Mine Warfare Environmental and Tactical Decision Aid Library (MEDAL) is currently undergoing fleet and JMCIS certification and will be available for fleet use and installation in FY 96. The first installations of MEDAL will be in conjunction with initial JMCIS installations on four *Avenger*-class MCMs in FY 96.

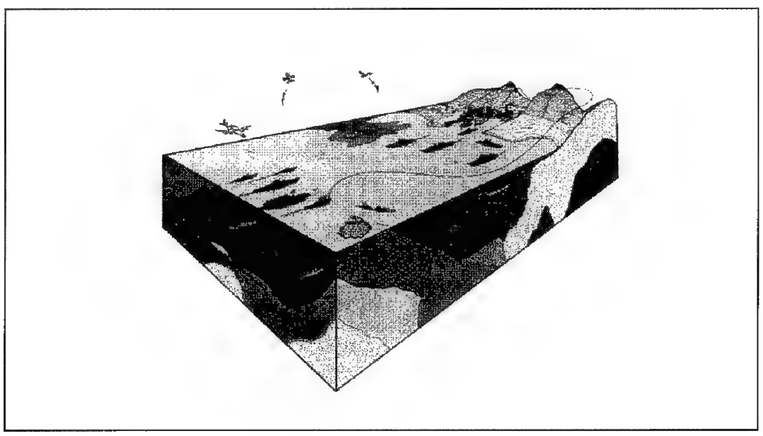
Future plans for MCM C^4I will include similar installations on USS *Inchon* (MCS-12), AMCM and EOD shore-based mobile command and control vans and tracking/data link capability for AMCM units.

When complete, Command and Control centers for the dedicated MCM force will be outfitted with standard, fleet-compatible C^4I systems in an architecture that will enable tactical data to flow when and where required.

Appendix H.

MINE WARFARE METEOROLOGY AND OCEANOGRAPHY (METOC) PROGRAMS

In accordance with theater Commanders-in-Chief priorities, COMNAVMETOC-COM ships, aircraft and commands collect, process, quality control, catalog, and disseminate global/regional Mapping, Charting, and Geodesy (MC&G) data (bathymetry, geodetic information, medium scale bottom mapping, feature morphology, etc.) and oceanographic data (temperature, salinity, conductivity, optical properties, acoustics, biological information, sediment properties, etc.) for use by mine warfare forces. In addition to standard METOC data collection efforts, alternative data acquisition methods such as cooperative hydrographic and oceanographic programs obtain data from participating foreign nations.



Dedicated high-resolution MC&G survey operations are conducted when and where feasible by COMNAVMETOCCOM vessels in advance of potential conflicts. Current RDT&E programs are developing systems that will allow MC&G collection by combatants or covert collection by all-source systems. These systems will collect, process, and quality control all-source METOC data from national and international sources for specific contingency areas in direct support of MCM operations.

The following Naval Oceanography and Meteorology programs have direct applicability to real-time support of MCM operations.

- Mini-Rawin System (MRS) is a portable off-the-shelf upper air sounding system that provides a key element for environmental observations.
- Tactical Environmental Support System (TESS) (3)/Naval Oceanographic Data Distribution and Expansion System (NODDES) is a data receiving, storing, processing, display and communications system that is a key element in the MCM environmental support architecture.
- NTCS-A/NCCS-A Integrated Tactical Environmental System (NITES) is an extension of TESS/NODDES for METOC data management for non-oceanographers that provides environmental support to small combatants like MCMs and MHCs.
- Shipboard Meteorological and Oceanographic Observing System (SMOOS) is a suite of oceanographic and meteorological sensors installed aboard TESS (3)-equipped ships.
- Mapping, Charting, and Geodesy Techniques encompass a number of systems to improve near-shore bathymetry, Special Operations Forces (SOF) surveillance needs, and Remotely Operated Vehicle (ROV)/Autonomous Undersea Vehicle (AUV) systems for collection of Mine Warfare-relevant parameters. Data collected/analyzed by systems developed in this project are critical for effective prosecution of MCM.
- Air Ocean Prediction develops computer-based numerical models of the ocean and the atmosphere that offer the prognostic ability to forecast future values of important mine warfare environmental parameters.
- Satellite Ocean Tactical Applications (SOTA) is a program that is developing and demonstrating techniques for using various space-based and theater-based sensors to quantify environmental parameters. These remote sensing platforms of various spatial and electromagnetic spectral resolutions provide the ability to directly measure values of many critical mine warfare environmental parameters.
- Air Ocean Data Assimilation is developing new models, data collection and assimilation techniques to inject environmental data into tactical decision aids. This is the tactical equivalent of the Air Ocean Prediction Program.
- Precise Timing/Time Interval and Astrometry (PTTI&A) is upgrading the accuracy of the Naval Observatory master clock system that will significantly impact the precision navigation capabilities of MCM ships.

Appendix I.

GLOSSARY

AAV	Assault Amphibian Vehicle
ACAT	Acquisition Category
ACI	Accelerated Capabilities Initiative
ACTD	Advanced Concept Technology Demonstration
AFS	Acoustic Firing System
AFCS	Automatic Flight Control System
ALISS	Advanced Lightweight Influence Sweep System
ALMDS	Airborne Laser Mine Detection System
AMCM	Airborne Mine Countermeasures
AMDS	Advanced Mine Detection System
AMNS	Airborne Mine Neutralization System
AOA	Amphibious Objective Area
APOBS	Anti-Personnel Obstacle Breaching System
ARG	Amphibious Ready Group
ARS	Advanced Radiographic System
ASD	Area Search Detachment
ASW	Anti-Submarine Warfare
ATD	Advanced Technology Demonstration
ATG	Afloat Training Group
AUV	Autonomous Undersea Vehicle
BLN	Breach Lane Navigation
C^2	Command and Control
C^3I	Command, Control, Communications, & Intelligence
C^4I	Command, Control, Communications, Computers & Intelligence
CAD	Computer-Aided Detection
CAPTOR	Mk 60 EnCAPsulated TORpedo (ASW mine with Mk 46 torpedo)
CBV	Combat Breacher Vehicle
CD-ROM	Compact Disc-Read Only Memory
CEB	Combat Engineer Battalion
CLDG	Closed Loop Degaussing
CLZ	Craft Landing Zone
CM	Countermeasure(s)
CNA	Center for Naval Analyses
CNO	Chief of Naval Operations
COBRA	Coastal Battlefield Reconnaissance and Analysis
COEA	Cost and Operational Effectiveness Analysis
COMINEWARCOM	Commander, Mine Warfare Command
COMNAVSURFGRU	Commander, Naval Surface Group
CONOPS	CONcept of OPerationS
CONUS	CONtinental United States

COTS ....Commercial-off-the-Shelf
CSS..Coastal Systems Station
CTD ....Conductivity, Temperature, and Depth sensor
CV ....Aircraft Carrier (conventionally powered)
CVBG ....Aircraft Carrier Battle Group
CVN ....Aircraft Carrier (nuclear powered)
DASN(MUW) ....Deputy Assistant Secretary of the Navy, Mine and Undersea Warfare
DEMNS ....Distributed Explosive Mine Neutralization System
Det(s) ....Detachment(s) (as in "EOD Dets")
DET ....Distributed Explosive Technologies
DEU ....Diver Evaluation Unit
DS/OAS ....Deep Submergence/Obstacle Avoidance System
DWLS ....Deep Water Lift System
EC..Engineering Change
ENATD..Explosive Neutralization Advanced Technology Demonstration
EOD ....Explosive Ordnance Disposal
EODMU ....Explosive Ordnance Disposal Mobile Unit
EPA ....Environmental Protection Agency
ESM ....Electronic Support Measures
EXUS ....Experimental Under Ice Sonar
FACDAR......................................Forward Area Combined Degaussing and Acoustic Range
FLIR..Forward Looking Infrared
FMFM..Fleet Marine Force Manual
FMWC ....Fleet Mine Warfare Center
GCE ....Ground Combat Element
GPS ....Global Positioning System
GRP ....Glass-Reinforced Plastic
HARM ....High-Speed Anti-Radiation Missile
HELMINERON ....Helicopter Mine Countermeasures Squadron
HF ....High Frequency
HM ....Helicopter Mine Countermeasures
ID ....Identification
IDBMS ....Integrated Database Management System
IDMS ....Improved Deep-Moored Sweep
IFF ....Identification Friend or Foe
IOC..Initial Operational Capability
IRST..Infrared Search and Track
JAMC ....Joint Amphibious Mine Countermeasures
JAST..Joint Advanced Strike Technology
JDAM ....Joint Direct Attack Munition
JMCIS..Joint Maritime Command Information System
LAV ....Light Armored Vehicle
LGB ....Laser-Guided Bomb
LCAC ....Landing Craft, Air-Cushion
LIDAR ....Light detection and ranging high-resolution airborne electro-optical imaging device

LMRS	Long-term Mine Reconnaissance System
LPH	Helicopter Landing Ship
LSM	Littoral Sea Mine
MACS	Magnetic Countermine System
MAD	Magnetic Anomaly Detector
MAG	Marine Air Group
MAGTF	Marine Air-Ground Task Force
MARTF	Magnetic, Acoustic, and Ranging Test Facility
MCAC	Multi-purpose Craft, Air Cushion
MCD	Mobile Communications Detachment
MCM	Mine Countermeasures
MCMV	Mine Countermeasures Vehicle
MCS	Mine Countermeasures Command, Control, and Support Ship
MC&G	Mapping, Charting & Geodesy
MEDAL	Mine Warfare Environmental Decision Aids Library
METOC	Meteorology and Oceanography
M/F	Minefield
MHC	Minehunter, Coastal
MIW	Mine Warfare
MMS	Marine Mammal System
MNS	Mine Neutralization System or Mission Needs Statement
MOMAG	Mobile Mine Assembly Group
MOP	Magnetic Orange Pipe
MRS	Mini-Rawin System
MSO	Minesweeper, Ocean
MSR	Magnetic Silencing Range
MTEDS	MCM Tactical Environmental Data System
N85	Director, Expeditionary Warfare
NDI	Non-Developmental Item
NEO	Non-combatant Evacuation Operation
NITES	NTCS-A/NCCS-A Integrated Tactical Environmental Subsystem
NMRS	Near-term Mine Reconnaissance System
NODDES	Naval Oceanographic Data Distribution and Expansion System
NR	Naval Reserve
NRF	Naval Reserve Force
NSSN	New Attack Submarine
NSW	Naval Special Warfare
NTCS-A	Navy Tactical Command System Afloat
OBS	Obstacle Breaching System
OCD	Obstacle Clearance Detachment
ONR	Office of Naval Research
ORCA	Oceanographic Remotely-Controlled Automaton
P3I	Pre-Planned Product Improvement
PEO(MIW)	Program Executive Officer, Mine Warfare

PINS ....Precise Integrated Navigation System
PLGR ....Precise Lightweight Global Positioning System Receiver
POM ....Program Objectives Memorandum
PTTI&A ....Precise Timing/Time Interval and Astrometry
PWRMS ....Prepositioned War Reserve Mine Stockpile
RAMICS ....Rapid Airborne Mine Clearance System
RAWIN..Radio-Wind (A balloon-carried radio-telemetered atmospheric sensor)
R&D ....Research and Development
RDT&E ....Research, Development, Test, and Evaluation
RMS ....Remote Minehunting System
RMOP..Remote Minehunting Operational Prototype
ROV ....Remotely Operated Vehicle
SABRE ....Shallow-water Assault Breaching system
SAR ....Synthetic Aperture Radar
SEAL ....Sea-Air-Land (special warfare forces)
SLAM ....Stand-off Land Attack Missile
SLMM ....Submarine-Launched Mobile Mine
SLOC ....Sea Line of Communication
SMB ....Standoff M/F Breacher
SMCM ....Surface Mine Countermeasures
SMOOS..Shipboard Meteorological and Oceanographic Observing System
SOF ....Special Operations Forces
SOTA ....Satellite Ocean Tactical Applications
SSDS ....Single Ship Deep Sweep
SSN ....Attack Submarine (nuclear powered)
SW ....Shallow Water
SWMCM......................................Shallow-Water Mine Countermeasures
SZ..Surf Zone
TBMD..Theater Ballistic Missile Defense
TCS ....Television Camera System
TDD ....Target Detection Device
TENCAP......................................Tactical Exploitation of National Capabilities
TESS ....Tactical Environmental Support System
TLAM..Tomahawk Land Attack Missile
TWMP ....Track Width Mine Plow
UAV ....Unmanned Aerial Vehicle
UBA ....Underwater Breathing Apparatus
USCG ....U.S. Coast Guard
UUV ....Unmanned Underwater Vehicle
UXO ....Unexploded Ordnance
VEMS ....Versatile Exercise Mine System
VSW ....Very Shallow Water
XBT ....Expendable Bathythermograph